UTOPIA INPUT DESCRIPTION

The UTOPIA input are based upon 80 character ‘card images’. The formats for each input must be followed for correct interpretation of the inputs. The inputs are specified by keywords followed by integer or real (floating point) values.

The input keywords are of two types:

Primary Identifiers- Specify the major function to be input.

Secondary Identifiers- Specify the particular aspect of a primary identifier to be input.

The following rules apply to Primary Identifiers:

1. The first ten columns are reserved for the primary identifier, left-justified.
2. The input is terminated by FINIS beginning in column 1.
3. Run description cards may be inserted in front of the first primary identifier if columns 1 to 10 are left blank.

The following rules apply to Secondary Identifiers:

4. The secondary identifier must appear left justified in columns 11 to 16.
5. The secondary identifiers associated with a primary identifier must follow the primary identifier as a group. The group is terminated with END beginning in column 11.
6. Only mandatory identifiers are essential.
7. The secondary identifiers may be within any order within a group.
8. Multiple secondary identifiers of the same name may exist within a group. The last identifier of the same name sets the input.

In the following description, I_1 denotes the first integer field, I_2 denotes the second integer field, etc. Similarly, R_1denotes the first real field. The specific format is given with each identifier.

Any card image with a # character in column one is completely ignored.

USING UPDATE

UPDATE (or nupdate) is a file maintenance program which is used to make temporary alterations to UTOPIA. The UTOPIA source code has been divided into decks, where each subroutine is a separate deck and each deck has its lines numbered for identification.

The basic structure of a modifications file is:

```
*IDENT MODSET
*INSERT DECK1.12
     ..............
     ..............
*DELETE DECK2.34
     ..............
     ..............
*INSERT DECK3.567
*DECK DECK4
     SUBROUTINE DECK4
     ..............
     ..............
     END
*COMPILE DECK1, DECK2, DECK3, DECK4
```

The above inputs to UPDATE would insert 2 lines of code after line 12 of the deck called DECK1. Line 34 of DECK2 would be deleted and 2 lines of code inserted in its place. After the last line of DECK3, a new subroutine with the name of DECK4 is being inserted. Any deck appearing on an UPDATE directive card must also appear on the COMPILE card. Since DECK4 has been declared to be a deck, it has to be included on the COMPILE card.

PRIMARY IDENTIFIER: INITIAL

The inputs associated with the primary identifier INITIAL are used to specify the *a priori* information about the spacecraft trajectory (initial time and state) and the *a priori* estimation information (initial state covariance and noise). The EPOCH1, POS and VEL cards are mandatory. The secondary identifiers, summarized below, are described in detail on the following pages.

EPOCH1 – Specify epoch year, month and day. MANDATORY.

EPOCH2 – Specify epoch hour, minute and second.

EPOCH3 – Specify epoch Julian date (UTC). Mandatory if EPOCH1 is missing.

PDIAG1 – Specify epoch position variances.

PDIAG2 – Specify epoch velocity variances.

POS – Specify epoch satellite position or orbit elements. MANDATORY.

VEL – Specify epoch satellite velocity or orbit elements.

Primary Identifier: INITIAL

Secondary Identifier: EPOCH1

Format: 10X, A6, 2I2, 3E20.13

Purpose: Define initial year, month and day (UTC). MANDATORY INPUT.

Data Field	Default Value	Description
R_1	0.0	Initial year.
R_2	0.0	Initial month.
R_3	0.0	Initial day.

Primary Identifier: INITIAL

Secondary Identifier: EPOCH2

Format: 10X, A6, 2I2, 3E20.13

Purpose: Define initial hour, minute and second (UTC).

Data Field	Default Value	Description
R_1	0.0	Initial hour.
R_2	0.0	Initial minute.
R_3	0.0	Initial second.

Primary Identifier: INITIAL

Secondary Identifier: EPOCH3

Format: 10X, A6, 2I2, 3E20.13

Purpose: Define initial Julian date (UTC). (Mandatory input if EPOCH1 is not used).

Data Field	Default Value	Description
R_1	0.0	Whole part of Julian date of initial epoch.
R_2	0.0	Fractional part of Julian date of initial epoch.

Primary Identifier: INITIAL

Secondary Identifier: PDIAG1

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set the initial position variances.

Data Field	Default Value	Description
I_1	0	*A priori* covariance print control. If = 0, do not print the diagonal elements of P. If = 1, print the diagonal elements of P.
I_2	0	*A priori* covariance system identifier. If = 0, Cartesian coordinates X,Y,Z. If = 1, radial, transverse and normal components.
R_1	1.0E+40	Initial variance for X (or R) in m^2.
R_2	1.0E+40	Initial variance for Y (or T) in m^2.
R_3	1.0E+40	Initial variance for Z (or N) in m^2.

Primary Identifier: INITIAL

Secondary Identifier: PDIAG2

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set the initial velocity variances.

Data Field	Default Value	Description
R_1	1.0E+40	Initial variance for $\dot{X}$ (or $\dot{R}$) in m^2/s^2.
R_2	1.0E+40	Initial variance for $\dot{Y}$ (or $\dot{T}$) in m^2/s^2.
R_3	1.0E+40	Initial variance for $\dot{Z}$ (or $\dot{N}$) in m^2/s^2.

Primary Identifier: INITIAL

Secondary Identifier: POS

Format: 10X, A6, 2I2, 3E20.13

Purpose: Define initial satellite position or orbital elements. MANDATORY INPUT.

Data Field	Default Value	Description
I_1	0	Denotes whether position (X,Y,Z) or orbital elements (a,e,i) are being given. If = 0, X, Y, Z are given. If = 1, a, e, i are given.
I_2	0	Specifies coordinate system used for initial state. If = 0, epoch 2000.0 non-rotating. If = 1, true of date, non-rotating. If = 2, rotating spin-axis body fixed (IRV). If = 3, rotating spin-axis body fixed. If = 4, mean-of-date, non-rotating. If = 5, epoch 1950.0, non-rotating.
R_1	0.0	X-coordinate or semi-major axis, a.
R_2	0.0	Y-coordinate or eccentricity, e.
R_3	0.0	Z-coordinate or inclination, i.

Notes: Units are meters and degrees unless $I_2 = 2$. For $I_2 = 2$, the units are feet.

Primary Identifier: INITIAL

Secondary Identifier: VEL

Format: 10X, A6, 2I2, 3E20.13

Purpose: Define initial satellite velocity or orbital elements. MANDATORY INPUT.

Data Field	Default Value	Description
R_1	0.0	X-velocity or argument of perigee, ω.
R_2	0.0	Y-velocity or longitude of the node, Ω.
R_3	0.0	Z-velocity or mean anomaly (M).

Notes: Coordinate system and type of inputs are determined by I_1 and I_2 on POS card.

Units are meters per second and degrees unless I_2 = 2. For I_2 = 2, the units are .01 feet per second.

PRIMARY IDENTIFIER: RUNMODE

The inputs associated with the primary identifier RUNMODE determine UTOPIA's execution mode. If one of the estimation modes is requested, the number of iterations, convergence criteria and multiple arc option are also set here. The secondary identifiers, summarized below, are described in detail on the following pages.

ITER – Specify the number of iterations.

MODE – Specify the execution mode.

NARC – Specify multiple arc count.

POSMIN – Specify MODE 4 convergence criteria.

RESTRT – Activate MODE 4 restart option.

RMSFRA – Specify MODE 4 convergence criteria.

SIGPOS – Specify MODE 4 convergence criterion.

UPDATE – Batch estimation control.

UPDPDP – Pass parameter update control

Primary Identifier: RUNMODE

Secondary Identifier: ITER

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set maximum number of iterations.

Data Field	Default Value	Description
I_1	0	Number of iterations of the measurement data in MODE 4.

Primary Identifier: RUNMODE

Secondary Identifier: MODE

Format: 10X, A6, 2I2, 3E20.13

Purpose: Define the execution mode.

Data Field	Default Value	Description
I_1	2	The program execution mode. If = 1, not used. If = 2, prediction/comparison. If = 3, measurement residuals. If = 4, batch estimation. If = 5, data simulation.

Primary Identifier: RUNMODE

Secondary Identifier: NARC

Format: 10X, A4, I4, I2, 3E20.13

Purpose: Set the multiple arc count.

Data Field	Default Value	Description
I_1	1	Number of arcs to process in batch estimation mode.
R_1	1.	Initial arc number (used only if positive).

Primary Identifier: RUNMODE

Secondary Identifier: POSMIN

Format: 10X, A6, 2I2, 3E20.13

Purpose: Input the batch estimation convergence criterion for the test of the position vector change.

Data Field	Default Value	Description
R_1	0.01	Magnitude of the position vector change (meters) to be used in convergence test.

Note: The iteration control is set for only one more pass through the data whenever,

$$(\Delta x^2 + \Delta y^2 + \Delta z^2)^{1/2} < R_1$$

where Δx, Δy and Δz are the current iteration changes in the orbit conditions.

Primary Identifier: RUNMODE

Secondary Identifier: RESTRT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate MODE 4 restart option.

Data Field	Default Value	Description
I_1	0	Restart identifier. If = 0, initialize accumulation and integration normally. If = 1, not used. If = 2, restart using RESTRT file.
I_2	0	Number of arcs on RESTRT to be skipped.
R_1	<first arc>	Maximum arc length (days) of any arc in RESTRT file.

Notes:

(1) A RESTRT file is simply a REPORT file from a previous run. Multiple REPORT files can be appended together and the NARC input increased accordingly.

(2) If needed, I_2 is allowed to be 3 or 4 digits long.

Primary Identifier: RUNMODE

Secondary Identifier: RMSFRA

Format: 10X, A6, 2I2, 3E20.13

Purpose: Input the batch estimation convergence criterion for the test based on the difference between the predicted and computed weighted data residual RMS.

Data Field	Default Value	Description
R_1	0.01	Fractional difference in weighted data residual RMS to be used in convergence test.

Note: The iteration control is set for only one more pass through the data whenever,

$$| WRMS(P) - WRMS(C) | / WRMS(C) < R_1$$

where $WRMS(P)$ and $WRMS(C)$ are the predicted and computed weighted data residual RMS, respectively. $WRMS(P)$ is an output from the Givens rotation solution of the least squares problem.

Primary Identifier: RUNMODE

Secondary Identifier: SIGPOS

Format: 10X, A6, 2I2, 3E20.13

Purpose: Input the batch estimation convergence criterion for the test based on the formal standard deviation of the satellite initial position.

Data Field	Default Value	Description
R_1	1.0E+10	Maximum acceptable position standard deviation (meters). If the position standard deviation exceeds R_1, iteration for the arc is stopped and no update to the estimation vector is performed.

Primary Identifier: RUNMODE

Secondary Identifier: UPDATE

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate or suppress batch estimation in MODE 4.

Data Field	Default Value	Description
I_1	1	Estimation control. If = 0, do not perform batch estimation or allocate central memory usually required for estimation. If = 1, perform batch estimation. If = 2, perform batch estimation, but do not update parameters between arcs. (A fatal error will result if ITER > 0, since this option is inconsistent with this case.).

Primary Identifier: RUNMODE

Secondary Identifier: UPDPDP

Format: 10X, A6, 2I2, 3E20.13

Purpose: Indicate status of pass dependent update file

Data Field	Default Value	Description
I_1	1	Pass dependent update control flag If = 0, pass dependent updates are not available on UPDPDP If = 1, pass dependent updates are available on UPDPDP

PRIMARY IDENTIFIER: FORCES

The inputs associated with the primary identifier FORCES determine the force model to be used in UTOPIA. However, the estimation of some dynamical parameters is also activated in FORCES. External data bases, such as the geopotential (GEO), solar flux data (FLXDAT), and the planetary ephemeris (EPHDAT), must be provided by the user prior to the execution of UTOPIA. The secondary identifiers, summarized below, are described in detail on the following pages.

ATMROT − Specify atmosphere rotation rate for drag calculations.

AVERTN − Activate average radial, transverse, and normal acceleration.

BFBIAS − Activate spacecraft body-fixed bias accelerations.

CNSDOT − Activate linear rates for geopotential coefficients.

DENCOR − Activate once/rev atmospheric density correction.

DRAG − Activate drag; specify density model and satellite model.

DRAG1 − Specify variable area model for satellite body.

DRAG2 − Specify exponential atmosphere parameters.

DRAGL − Activate Lageos-type empirical tangential acceleration model.

DRAGP − Activate periodic tangential acceleration model.

DRGCMP − Activate drag compensation model.

DTIDES − Activate the dynamic solid Earth tides and specify Love number.

ERADP − Activate Earth radiation pressure.

ERADP1 − Specify Earth albedo and emissivity model.

FLUX − Specify solar flux and geomagnetic index for atmosphere models.

GEO − Activate geopotential perturbations.

GEOPOL − Deactivate dependence of forces on polar motion.

GEOSUB − Specify substitute values for individual geopotential coefficients.

GM − Specify Earth gravitational constant.

HPDENS − Specify Harris-Priester atmosphere parameters.

INDRJ2 − Activate indirect effect of the Moon and Sun on the Earth's J_2.

JnDOT − Activate linear rates for zonal geopotential coefficients.

JUPITE − Activate perturbation due to Jupiter.

MACRO − Activate surface force macro-model.

MACRO1 − Specify individual surface properties for box-wing macro-model.

MARS − Activate perturbation due to Mars.

MERCUR − Activate perturbation due to Mercury.

MMAX – Specify the maximum sectorial and tesseral order.

MOON – Activate perturbation due to Moon.

NEPTUN – Activate perturbation due to Neptune.

NJMAX – Specify the maximum zonal harmonic degree.

NMAX – Specify the maximum sectorial and tesseral degree.

NORMAL – Specify normal component of RTN acceleration.

ORIENT – Specify orientation of satellite-centered coordinate system.

OTIDES – Activate the dynamic ocean tides and specify amplitudes.

PANELS – Activate solar panel model for drag and/or solar radiation pressure.

PLUTO – Activate perturbation due to Pluto.

RADIAL – Specify radial component of RTN acceleration.

RADPR – Activate solar radiation pressure and specify satellite model.

RADPR1 – Specify additional satellite characteristics for solar radiation pressure.

RANDOM – Activate random/stochastic errors in force model parameters.

RELPRT – Activate the relativistic perturbing acceleration.

RNFCTS – Set stochastic error model for tangential acceleration.

ROTDEF – Activate dynamical effect of rotational deformation.

RTNPRT – Activate periodic radial, transverse and normal acceleration.

SABIAS – Specify solar array pitch angle bias.

SATID – Set satellite identification number and mass.

SATURN – Activate perturbation due to Saturn.

SHADOW – Specify model for Earth's shadow.

SOLAX – Specify direction of solar panel rotation axis.

SPINAX – Specify spin axis direction for spinning satellites.

SPRES – Specify the solar constant for solar and Earth radiation pressure calculations.

SUN – Activate perturbation due to Sun.

TRANSV – Specify transverse component of RTN acceleration.

URANUS – Activate perturbation due to Uranus.

VENUS – Activate perturbation due to Venus.

YARKOV – Activate thermal thrust due to heating by the Earth and Sun.

YARKV1 – Specify thermal delay constants for Lageos-type thermal thrust

Primary Identifier: FORCES

Secondary Identifier: ATMROT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set the atmospheric rotation parameter which is the ratio between the rotation rate of the atmosphere at the satellite altitude and the Earth's rotation rate.

Related Inputs: DRAG, DRAG1, DRAG2

Data Field	Default Value	Description
R_1	1.0	Atmospheric rotation parameter (ARP)

Primary Identifier: FORCES

Secondary Identifier: AVERTN

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate the average radial, transverse, and normal acceleration (RTN) model.

Data Field	Default Value	Description
I_1	0	RTN perturbation switch: If = 0, the average RTN model is deactivated. If = 1, the average RTN model is activated (partials wrt position and velocity ignored). If = 2, the average RTN model is activated (partials wrt position and velocity included).
R_1	0.0	Average radial acceleration (10^{-9} m/sec^2).
R_2	0.0	Average transverse acceleration (10^{-9} m/sec^2).
R_3	0.0	Average normal acceleration (10^{-9} m/sec^2).

Note: Subarc values for the radial, transverse, and normal components are specified by the AVERAD, AVETRA, and AVENOR cards, respectively.

Primary Identifier: FORCES

Secondary Identifier: BFBIAS

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate constant accelerations in satellite body-fixed coordinates.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model If = 1, include in force model
R_1	0.0	Constant x-bias acceleration (10^{-12} m/sec^2).
R_2	0.0	Constant y-bias acceleration (10^{-12} m/sec^2).
R_3	0.0	Constant z-bias acceleration (10^{-12} m/sec^2).

Note: Orientation of satellite is specified by ORIENT input.

Primary Identifier: FORCES

Secondary Identifier: CNSDOT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify linear changes in geopotential coefficients.

Related Inputs: GEO, JnDOT, POLEPO, POLRAT

Data Field	Default Value	Description
I_1		Degree of spherical harmonic coefficient.
I_2		Order of spherical harmonic coefficient.
R_1		Change in normalized coefficient ($\times 10^{12}$) per year.

Notes:

(1) Currently, $\dot{\bar{C}}_{2,1}$ and $\dot{\bar{S}}_{2,1}$ are the only non-zonal rates allowed.

(2) Zonal rates can also be entered using the JnDOT card.

Primary Identifier: FORCES

Secondary Identifier: DENCOR

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate the once/rev density correction model.

Data Field	Default Value	Description
I_1	0	Density correction switch: If = 0, density correction model is deactivated. If = 1, the density correction model is activated.
R_1	0.0	Coefficient of COSINE part of once/rev density correction
R_2	0.0	Coefficient of SINE part of once/rev density correction

Primary Identifier: FORCES

Secondary Identifier: DRAG

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set the atmospheric drag model.

Data Field	Default Value	Description
I_1	0	Drag model: If = 0, no drag. If = 1, exponential model. If = 2, Harris-Priester model. If = 3, Jacchia-Roberts 1971 model. If = 4, Jacchia 1977 model. If = 5, Density and temperature model (DTM)
R_1	0.0	Cross-sectional area of the satellite (m^2).
R_2	2.0	Drag coefficient C_D.
R_3	0.0	$\dot{C}_D$.

Note: To specify exponential model parameters, see DRAG2 card. For other models, see FLUX card. (See also HPDENS card for Harris-Priester.)

Primary Identifier: FORCES

Secondary Identifier: DRAG1

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify variable area model for satellite body.

Data Field	Default Value	Description
I_1	0	Variable area model identifier: If = 0, use constant area model. If = 1, use rectangular box (orientation determined by ORIENT input)
R_1	0.0	Cross-sectional area as viewed from front (roll axis).
R_2	0.0	Cross-sectional area as viewed from the side (pitch axis).
R_3	0.0	Cross-sectional area as viewed from below (yaw axis).

Primary Identifier: FORCES

Secondary Identifier: DRAG2

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set the spherically symmetric exponential atmosphere model parameters.

Data Field	Default Value	Description
R_1	4.0E-3	β inverse scale height (km^{-1}).
R_2	80.0	h_o reference height (km).
R_3	1.2E-14	ρ_o reference density (kg/m^3).

Note: The density ρ is modeled as $\rho = \rho_o \exp(-\beta (h - h_o))$, where h and h_o are heights above a sphere of radius 6371 km.

Primary Identifier: FORCES

Secondary Identifier: DRAGL

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate Lageos-type empirical tangential acceleration model (empirical drag).

Data Field	Default Value	Description
I_1	0	Empirical drag model identifier: If = 0, no empirical drag. If = 1, empirical drag as a function of body-fixed velocity. If = 2, empirical drag as a function of inertial velocity.
R_1	first arc epoch	Julian date (ET) of epoch for $\dot{C}_t$ and periodic terms (changed only if non-zero).
R_2	0.0	Empirical drag coefficient C_t (10^{-12} m/sec^2).
R_3	0.0	$\dot{C}_t$ (10^{-12} m/sec^2/day).

Primary Identifier: FORCES

Secondary Identifier: DRAGP

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set the initial values of the empirical periodic drag terms.

Data Field	Default Value	Description
I_1		Number of this periodic drag term.
R_1	0.0	Cosine coefficient of the I_1 periodic drag term.
R_2	0.0	Sine coefficient of the I_1 periodic drag term.
R_3	1.0	Period in days of the I_1 periodic drag term.

Notes:

(1) Units for R_1 and R_2 are 10^{-12} m/s^2.

(2) Empirical drag force must be activated using DRAGL input.

(3) Epoch for periodic terms can be specified using DRAGL input.

Primary Identifier: FORCES

Secondary Identifier: DRGCMP

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate drag compensation model. Drag is deactivated and the transverse component of the solar and Earth radiation pressure acceleration is zeroed out.

Data Field	Default Value	Description
I_1	0	Drag compensation identifier: If = 0, drag compensation is deactivated. If = 1, drag compensation is activated.

Primary Identifier: FORCES

Secondary Identifier: DTIDES

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate dynamic solid Earth tides and set Love number.

Data Field	Default Value	Description
I_1	0	Dynamic solid Earth tide identifier: If = 0, exclude from force model. If = 1, include in force model. If = 2, include in force model, but exclude frequency dependent diurnal band.
I_2	4	Maximum degree solid Earth tide to include (changed only if $I_2 > 1$).
R_1	–	Substitute second-degree Love number (used only if non-zero).
R_2	0.0	Lag angle (degrees)
R_3	430.0	Period of free-core nutation (changed only if non-zero).

Notes:

1) The zero-frequency dynamic tide correction to $\overline{C}_{20}$ is suppressed.

2) IERS value for R_3 is 461.79 (460.53 sidereal days).

3) The sign of the lag angle is such that for a dissipative Earth the lag is positive.

Primary Identifier: FORCES

Secondary Identifier: ERADP

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set Earth radiation pressure parameters.

Data Field	Default Value	Description
I_1	0	Earth radiation pressure identifier: If = 0, do not include in forces. If = 1, include in forces.
I_2	0	Number of rings for Earth radiation model.
R_1	0.0	Cross-sectional area of satellite (m^2).
R_2	0.0	Optical reflectivity coefficient η_{op}.
R_3	0.0	Infrared reflectivity coefficient η_{ir}.

Primary Identifier: FORCES

Secondary Identifier: ERADP1

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify coefficients for Earth albedo and emissivity models.

Data Field	Default Value	Description
R_1	2444960.5	Julian date of epoch for periodic terms (changed only if non-zero).
R_2	0.0	Global estimation control: If < 0.0, estimate all albedo and emissivity coefficients with *a priori* σ as specified on individual cards. If > 0.0, estimate all albedo and emissivity coefficients using R_2 as *a priori* σ (where not already specified on individual cards).
R_3	6378137.0	Radius of Earth (changed only if non-zero).

The albedo and emissivity cards are inserted immediately after the ERADP1 card and the end of the inputs is denoted by a blank card. The format for each card is

(10X, A2, I2, I2, F10.5, F15.10, F10.5, F15.10, F10.5)

A_1	Either AL (for albedo) or EM (for emissivity).
I_1	Degree of coefficient (<10).
I_2	Estimation identifier: If < 0, ignore this card. If = 0, do not estimate. If > 1, estimate.
R_1	Period associated with this term; if zero, then the term is constant.
R_2	Value of constant term or cosine coefficient.
R_3	Sigma for quantity in R_2.
R_4	Value of sine coefficient.
R_5	Sigma for quantity in R_4.

Primary Identifier: FORCES

Secondary Identifier: FLUX

Format: 10X, A6, 2I2, 3E20.13

Purpose: Define solar flux and geomagnetic index for atmospheric density models.

Data Field	Default Value	Description
I_1	0	Set source of flux values: If = 0, use data base from FLXDAT. If = 1, use constant values given by R_1, R_2 and R_3.
R_1	150.0	Smoothed 10.7 cm solar flux.
R_2	150.0	Actual 10.7 cm solar flux.
R_3	2.0	Geomagnetic planetary index k_p.

Notes:

(1) If $I_1 = 0$, then a flux data base (FLXDAT) for the appropriate time interval must be made available.

(2) For Harris-Priester model, only R_1 needs to be specified. The other inputs are ignored.

Primary Identifier: FORCES

Secondary Identifier: GEO

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate geopotential perturbation.

Data Field	Default Value	Description
I_1	1	Geopotential perturbation parameter: If = 0, exclude geopotential. If = 1, include geopotential.
I_2	0	Geopotential print parameter: If = 0, do not print geopotential coefficients on output. If = 1, print geopotential coefficients on output.
R_1	0.0	Replacement value for the Earth's gravitational constant (GM) in km^3/s^2 for use in geopotential computations (used only if non-zero).
R_2	0.0	Replacement value for the Earth's equatorial radius (RE) in meters, for use in the geopotential (used only if non-zero).
R_3	2446431.5 (1 Jan 86)	Epoch for time-dependent geopotential coefficients (changed only if non-zero).

Primary Identifier: FORCES

Secondary Identifier: GEOPOL

Format: 10X, A6, 2I2, 3E20.13

Purpose: Deactivate dependence of forces on polar motion.

Data Field	Default Value	Description
I_1	1	Dynamic polar motion flag: If = 0, polar motion is ignored when evaluating forces. If = 1, polar motion is included when evaluating forces.

Primary Identifier: FORCES

Secondary Identifier: GEOSUB

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify values to be substituted for individual geopotential coefficients.

Related Inputs: GEO, GEOEST, DGREST

The presence of this identifier indicates that one or more of the following cards will be used to reset the geopotential coefficients. Each card must be in the same format as the cards in the geopotential file, and the end is indicated by a blank card (or a card with END in columns 1−3). Should the characters ESTIM appear in columns 1−6, that coefficient or pair of coefficients will be estimated. See GEO file description for format of geopotential cards.

Primary Identifier: FORCES

Secondary Identifier: GM

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify gravitational constant of the Earth for computation of two-body and relativistic accelerations.

Data Field	Default Value	Description
R_1	398600.4415	GM of the Earth in km^3/sec^2 (if no value of GM is specified, the value from the geopotential file, if available, will be used).

Primary Identifier: FORCES

Secondary Identifier: HPDENS

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set Harris-Priester atmosphere parameters.

Data Field	Default Value	Description
R_1	1.0	Minimum bulge scale factor.
R_2	1.0	Maximum bulge scale factor.
R_3	4.0	Power of cosine term.

Primary Identifier: FORCES

Secondary Identifier: INDRJ2

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate indirect effect of the Moon and Sun on the Earth's J_2.

Data Field	Default Value	Description
I_1	0	Perturbation switch for the indirect effect of the Moon on the Earth's J_2: If = 0, exclude from force model. If = 1, include in force model.
I_2	0	Perturbation switch for the indirect effect of the Sun on the Earth's J_2: If = 0, exclude from force model. If = 1, include in force model.

Primary Identifier: FORCES

Secondary Identifier: JnDOT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate linear changes in the zonal geopotential coefficients.

Related Inputs: GEO, CNSDOT, GEOSUB, GEOEST

Data Field	Default Value	Description
$<n>$		Identifies degree of zonal ($2 \le n \le 70$)
R_1	0.0	Change in unnormalized zonal ($\times 10^{12}$) per year

Notes:

(1) JnDOT can be of the form J2DOT or J02DOT.

(2) Epoch for geopotential model is specified on GEO card.

Primary Identifier: FORCES

Secondary Identifier: JUPITE

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Jupiter and to set the reciprocal mass ratio.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.
R_1	1047.350	Reciprocal mass ratio (changed only if R_1 is non-zero).

Primary Identifier: FORCES

Secondary Identifier: MACRO

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate macro-model and specify orientation biases.

Related Inputs: MACRO1, ORIENT, CMOFF1, TELEM

Data Field	Default Value	Description
I_1	0	Macro-model indicator: If = 0, do not activate macro-model. If = 1, activate macro-model using TOPEX/ POSEIDON nominal values (macro-model inputs which have been previously set may be changed).

Primary Identifier: FORCES

Secondary Identifier: MACRO1

Format: 10X, A6, I2, 8F7.3, F6.2

Purpose: Specify surface properties for eight-surface box-wing macro-model.

Related Input: MACRO

Data Field	Default Value	Description
I_1		Surface indication:

I_1	1	2	3	4	5	6	7	8
face	$+x$	$-x$	$+y$	$-y$	$+z$	$-z$	+SA	−SA

R_1		Surface area (m^2)
R_2		Specular reflectivity
R_3		Diffuse reflectivity
R_4		Emissivity
R_5		Reference temperature (deg)
R_6		Temperature change (deg)
R_7		Cooling transition time (sec)
R_8		Heating transition time (sec)
R_9		Thermal inertia constant

Note: Description of TOPEX/POSEIDON macro-model is given in NASA TM 104564, Marshall et al., June 1992.

Primary Identifier: FORCES

Secondary Identifier: MARS

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Mars and to set the reciprocal mass ratio.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.
R_1	3098710.0	Reciprocal mass ratio (changed only if R_1 is non-zero).

Primary Identifier: FORCES

Secondary Identifier: MERCUR

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Mercury and to set the reciprocal mass ratio.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.
R_1	6023600.0	Reciprocal mass ratio (changed only if R_1 is non-zero).

Primary Identifier: FORCES

Secondary Identifier: MMAX

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set maximum order of the sectorial and tesseral harmonics.

Data Field	Default Value	Description
I_1	70	Maximum order to be included in geopotential.

Primary Identifier: FORCES

Secondary Identifier: MOON

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Moon.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.

Primary Identifier: FORCES

Secondary Identifier: NEPTUN

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Neptune and to set the reciprocal mass ratio.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.
R_1	19314.0	Reciprocal mass ratio (changed only if R_1 is non-zero).

Primary Identifier: FORCES

Secondary Identifier: NJMAX

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set the maximum degree of the zonal harmonics.

Data Field	Default Value	Description
I_1	70	Highest degree zonal to be included in the geopotential perturbations.

Primary Identifier: FORCES

Secondary Identifier: NMAX

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set the maximum degree of the sectorial and tesseral harmonics.

Data Field	Default Value	Description
I_1	70	Maximum degree to be included in the geopotential.

Primary Identifier: FORCES

Secondary Identifier: NORMAL

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify normal component of periodic RTN acceleration.

Data Field	Default Value	Description
R_1	0.0	Coefficient for COSINE part of periodic normal acceleration (10^{-9}m/sec^2).
R_2	0.0	Coefficient for SINE part of periodic normal acceleration (10^{-9}m/sec^2).

Primary Identifier: FORCES

Secondary Identifier: ORIENT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify orientation of satellite-centered coordinate system

Data Field	Default Value	Description
I_1	0	Orientation model identifier: If = 0, no orientation model selected. If = 1, fixed yaw-steering; satellite x-axis is kept in the inertial velocity plane. If = 2, satellite is yaw-steered to maintain x-axis in Earth-satellite-sun plane. If = 3, fixed yaw-steering; satellite x-axis is kept in ground track velocity plane. If = 4, TOPEX/POSEIDON orientation model.
I_2	0	TOPEX/POSEIDON yaw-steering control: If = 0, use nominal yaw-steering model. If = 1, use sequence-of-events file (SOE). If = 2, use and print attitude changes from SOE file.
R_1	15.0	Low β' limit for yaw-steering (deg).
R_2	80.0	High β' limit for yaw-steering (deg).
R_3	0.0	Yaw bias (deg).

Notes:

(1) The orientation model affects the solar panel, variable area, and y-bias models in FORCES and the center-of-mass offset models in STA/OBS.

(2) I_2, R_1, R_2 and R_3 apply only to TOPEX/POSEIDON model.

Primary Identifier: FORCES

Secondary Identifier: OTIDES

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate dynamic ocean tide perturbation.

Related Input: OTSUB

Data Field	Default Value	Description
I_1	0	Dynamic ocean tide model switch: If = 0, deactivate ocean tides. If = 1, activate ocean tides.
I_2	0	Ocean tide model print control: If = 0, minimal information printed. If = 1, full information printed.

Primary Identifier: FORCES

Secondary Identifier: OTSUB

Format: 10X, A6, 2I2, 3E20.13

Purpose: Change existing ocean tide coefficient value, add new tides to ocean tide model, or activate estimation of ocean tide coefficients.

Data Field	Default Value	Description

Special format ocean tide cards are read following the OTSUB card until a blank card (or a card with END in columns 1−3) is encountered. The format of an ocean tide card is (10X, I2, 1X, A7, A4, 2I2, 2X, 4E22.14, I2).

I_1	Estimation flag: If < 0, ignore this card. If = 0, use in model but do not estimate. If = 1, estimate only prograde tide. If = 2, estimate only retrograde tide. If = 3, estimate both prograde and retrograde tide.
A_1	Doodson argument number of this constituent.
A_2	Darwin name of this constituent.
I_2	Degree of this constituent.
I_3	Order of this constituent.
R_1	Cosine coefficient of prograde ocean tide (cm).*
R_2	Sine coefficient of prograde ocean tide (cm).*
R_3	Cosine coefficient of retrograde ocean tide (cm).*
R_4	Sine coefficient of retrograde ocean tide (cm).*
I_4	Unnormalized coefficients if 0; normalized otherwise.

* If blank, existing value of coefficient is unchanged.

Primary Identifier: FORCES

Secondary Identifier: PANELS

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate the effect of solar panels for solar radiation pressure and drag.

Data Field	Default Value	Description
I_1	0	Solar panel indicator for radiation pressure: If = 0, do not include solar panels. If = 1, include solar panels, assuming panels always remain oriented normal to the Sun. If = 2, include solar panels, assuming panels are constrained to rotate about one axis. If = 3, use TOPEX/POSEIDON macro-model for panels.
I_2	0	Solar panel indicator for drag: If = 0, do not include solar panels. If = 1, include solar panels, assuming panels always remain oriented normal to the Sun. If = 2, include solar panels, assuming panels are constrained to rotate about one axis. If = 3, use TOPEX/POSEIDON macro-model for panels.
R_1	0.0	Solar panel area (m^2).
R_2	0.0	Solar panel reflectivity coefficient.
R_3	0.0	Solar panel drag coefficient.

Note: If $I_1 = 2$ or $I_2 = 2$, specify orientation of satellite-centered coordinate system with the ORIENT input, and the direction of the solar panel axis of rotation with the SOLAX card.

Primary Identifier: FORCES

Secondary Identifier: PLUTO

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Pluto and to set the reciprocal mass ratio.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.
R_1	1.3E8	Reciprocal mass ratio (changed only if R_1 is non-zero).

Primary Identifier: FORCES

Secondary Identifier: RADIAL

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify radial component of periodic RTN acceleration.

Data Field	Default Value	Description
R_1	0.0	Coefficient for COSINE part of periodic radial acceleration (10^{-9} m/sec^2).
R_2	0.0	Coefficient for SINE part of periodic radial acceleration (10^{-9} m/sec^2).

Primary Identifier: FORCES

Secondary Identifier: RADPR

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set solar radiation pressure parameters.

Data Field	Default Value	Description
I_1	0	Solar radiation pressure identifier: If = 0, do not include in forces. If = 1, include in forces.
R_1	0.0	Cross-sectional area of spacecraft main body in m^2.
R_2	0.0	Reflectivity coefficient η
R_3	0.0	$\dot{\eta}$

Primary Identifier: FORCES

Secondary Identifier: RADPR1

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set additional satellite characteristics for solar radiation pressure modeling.

Data Field	Default Value	Description
I_1	0	Variable area model identifier: If = 0, use constant area model. If = 1, use rectangular box (orientation determined by ORIENT input). If = 2, use a vertical cylinder model.
R_1	0.0	Cross-sectional area as viewed from front (roll axis).
R_2	0.0	Cross-sectional area as viewed from the side (pitch axis).
R_3	0.0	Cross-sectional area as viewed from below (yaw axis).

Note: Only R_2 and R_3 need to be specified for vertical cylinder model ($I_1 = 2$).

Primary Identifier: FORCES

Secondary Identifier: RANDOM

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate random/stochastic errors in force model parameters. (Simulated errors not available in MODE 4.)

Related Inputs: RNFCTS

Data Field	Default Value	Description
I_1	0	Force model error control: If = 0, defeat force model errors. If = 1, allow generation of force model errors. If = 2, activate all dynamical model errors using defaults. (The default values will not be modified by subsequent inputs.)
R_1	0.03	Error (1σ) in reflectivity parameter
R_2	0.2	Fractional error (1σ) in semi-diurnal ocean tide parameters. Diurnal tide errors will use 1.5 R_2, and long period tides will use 2 R_2. (The errors will be capped at 2 mm, 6 mm and 15 mm, respectively.)
R_3	0.03	Error (1σ) for Earth albedo and emissivity parameters

Primary Identifier: FORCES

Secondary Identifier: RELPRT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate relativistic perturbing accelerations.

Related Inputs: BARYCN, GEOCEN

Data Field	Default Value	Description
I_1	0	Point-mass relativistic perturbation identifier: If = 0, exclude relativistic perturbation. If = 1, include geocentric (1-body) relativistic perturbations (including geodesic precession). If = 2, include full barycentric (n-body) relativistic perturbations. If = -1,include geocentric (1-body) relativistic perturbations (excluding geodesic precession).
I_2	0	Additional relativistic perturbations identifier (if I_1 is 0, this input is ignored): If = 0, exclude Lense-Thirring and relativistic oblateness effects. If = 1, include Lense-Thirring and relativistic oblateness effects. If = 2, include only Lense-Thirring precession. If = 3, include only relativistic oblateness effect.
R_1	1.0	General relativity parameter β.*
R_2	1.0	General relativity parameter γ.*
R_3	1.0	Scale parameter for Earth's angular momentum per unit mass **J** (9.8E+8 m^2/sec) for computing Lense-Thirring precession.*

* changed only if non-zero

Primary Identifier: FORCES

Secondary Identifier: RNFCTS

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set stochastic error model for tangential acceleration (activated by RANDOM card in FORCES).

Data Field	Default Value	Description
R_1	0.5	Standard deviation of random noise driving autoregressive process (picometer/sec/sec)
R_2	0.75	First-order autoregressive parameter
R_3	0.0	Second-order autoregressive parameter

Note: In current implementation, daily samples are generated and interpolated between; correlation time with default values of R_2 and R_3 is approximately 1 day.

Primary Identifier: FORCES

Secondary Identifier: RNFDRG

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate random 3-hr k_p values for simulation of density model errors.

Data Field	Default Value	Description
R_1	2.7	Standard deviation of k_p values.
R_2	55	Print control − indicates number of random k_p values to write to random error report file (RNFRPT).

Note: Generated k_p values are roughly random, but values are limited to the range between 0.75 and 8.75 regardless of the value of R_1.

Primary Identifier: FORCES

Secondary Identifier: ROTDEF

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate dynamical effect of rotational deformation.

Related Inputs: POLMOT, POLEPO, POLRAT

Data Field	Default Value	Description
I_1	0	Rotational deformation control flag: If = 0, do not include in forces. If = 1, include in forces.
R_1	0.3	Love number k_2 (changed only if non-zero).

Note: Epoch, mean values and mean rates for polar motion are specified in FRAME with POLEPO and POLRAT cards.

Primary Identifier: FORCES

Secondary Identifier: RTNPRT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate the periodic radial, transverse, and normal acceleration (RTN) model.

Data Field	Default Value	Description
I_1	0	RTN perturbation switch: If = 0, the periodic RTN model is deactivated. If = 1, the periodic RTN model is activated.
I_2	0	If non-zero, use alternate "pseudo-radial," along-track, and cross-track system.
R_1	1.0	Multiple of orbital period for use in periodic RTN acceleration (changed only if non-zero).
R_2	0.0	Initial phase of the angular argument to be used if a linear rate is desired rather than an orbit-dependent argument (deg).
R_3	0.0	Angular rate (deg/day). If R_3 is non-zero, the angular argument for the periodic RTN perturbation is defined by R_2 and R_3. Otherwise, the multiple of the orbit period specified by R_1 will be used.

Note: Values for the radial, transverse and normal components are specified by the RADIAL, TRANSV and NORMAL cards, respectively.

Primary Identifier: FORCES

Secondary Identifier: SABIAS

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify pitch bias for TOPEX/POSEIDON solar panel.

Related Inputs: ORIENT, PANELS, MACRO

Data Field	Default Value	Description
R_1		Solar panel pitch bias (degrees)

Note: If nominal solar panel pitch bias for TOPEX/POSEIDON is to be used, this card should not be present. Any value for R_1 (other than 999.) will override nominal pitch bias algorithm.

Primary Identifier: FORCES

Secondary Identifier: SATID

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set satellite identification number.

Data Field	Default Value	Description
R_1	0.0	Input conventional 7-digit identification number, e.g.,

Name	ID
ERS-2	9502101
GLONASS-67	9405003
GLONASS-63	9402102
GPS-36	9401601
METEOR-3(6)	9400301
STELLA	9306102
SPOT-3	9306101
METEOR-2 (21)	9305501
GPS-35	9305401
LAGEOS-2	9207002
TOPEX/POSEIDON	9205201
GLONASS-57	9204702
GLONASS-56	9204701
ERS-1	9105001
SPOT-2	9000501
ETALON-2	8903903
ETALON-1	8900103
AJISAI	8606101
GFZ-1	8601795
GEOSAT	8502101
SEASAT-1	7806401
LAGEOS-1	7603901
GEOS-3	7502701
STARLETTE	7501001
PEOLE	7010910
GEOS-2	6800201
DI-C	6701101
DI-D	6701401
GEOS-1	6508901
BEC	6503201

R_2	0.0	Satellite mass in kilograms.

Primary Identifier: FORCES

Secondary Identifier: SATURN

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Saturn and to set the reciprocal mass ratio.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.
R_1	3498.0	Reciprocal mass ratio (changed only if R_1 is non-zero).

Primary Identifier: FORCES

Secondary Identifier: SHADOW

Format: 10X, A6, 2I2, 3E20.13

Purpose: Determine model for Earth and Moon shadowing.

Data Field	Default Value	Description
I_1	0	Set type of shadow model: If = -1, deactivate shadowing. If = 0, use cylindrical model for Earth shadowing. If = 1, use conical model for Earth shadowing. If = 2, use conical model for Earth and Moon shadowing.
R_1	6402000.0	Set the radius of the Earth to be used in shadow model (m) (changed only if non-zero).
R_2	1738000.0	Set the radius of the Moon to be used in shadow model (m) (changed only if non-zero).

Primary Identifier: FORCES

Secondary Identifier: SOLAX

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify the solar panel axis of rotation in the satellite-centered coordinate (SCC) system.

Data Field	Default Value	Description
R_1	0.64279 SEASAT	x component of unit vector
R_2	0.76604 SEASAT	y component of unit vector
R_3	0.0 SEASAT	z component of unit vector

Primary Identifier: FORCES

Secondary Identifier: SPINAX

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify spin axis orientation for spinning satellites.

Related Inputs: YARKOV, YARKV1

Data Field	Default Value	Description
R_1	0.0	Right ascension of spin axis (deg)
R_2	0.0	Declination of spin axis (deg)

Note: Lageos-1 has a variable spin axis orientation model which is used only $R_1 = R_2 = 0.0$.

Primary Identifier: FORCES

Secondary Identifier: SPRES

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify the solar constant for solar and Earth radiation pressure calculations.

Data Field	Default Value	Description
R_1	4.560E-6	Solar constant at 1 A.U. in kg/m/sec^2.

Primary Identifier: FORCES

Secondary Identifier: SUN

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Sun and to set the reciprocal mass ratio.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.
R_1	1.0	Reciprocal mass ratio (changed only if R_1 is non-zero).

Primary Identifier: FORCES

Secondary Identifier: TRANSV

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify transverse component of periodic RTN acceleration.

Data Field	Default Value	Description
R_1	0.0	Coefficient for COSINE part of periodic transverse acceleration (10^{-9} m/sec^2).
R_2	0.0	Coefficient for SINE part of periodic transverse acceleration (10^{-9} m/sec^2).

Primary Identifier: FORCES

Secondary Identifier: URANUS

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Uranus and to set the reciprocal mass ratio.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.
R_1	22960.0	Reciprocal mass ratio (changed only if R_1 is non-zero).

Primary Identifier: FORCES

Secondary Identifier: VENUS

Format: 10X, A6, 2I2, 3E20.13

Purpose: An option to include the perturbation due to Venus and to set the reciprocal mass ratio.

Data Field	Default Value	Description
I_1	0	Perturbation switch: If = 0, exclude from force model. If = 1, include in force model.
R_1	408523.5	Reciprocal mass ratio (changed only if R_1 is non-zero).

Primary Identifier: FORCES

Secondary Identifier: YARKOV

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate thermal thrust (Yarkovsky effect) due to Earth and solar heating and asymmetric reflectivity on Lageos-type satellites.

Related Input: SPINAX, YARKV1

Data Field	Default Value	Description
I_1	0	Yarkovsky effect control flag: If = 0, do not include in force model. If = 1, include in force model.
R_1	0.0	Acceleration due to Earth Yarkovsky effect (picom/sec/sec).
R_2	0.0	Acceleration due to solar Yarkovsky effect (picom/sec/sec).
R_3	0.0	Asymmetric reflectivity (%).

Note: For Lageos-1, $R_1 \approx -6.2$, $R_2 \approx -80.0$, and $R_3 \approx 0.1$.

Primary Identifier: FORCES

Secondary Identifier: YARKV1

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify constants for Lageos-type delayed thermal thrust due to Earth and solar heating

Related Inputs: SPINAX, YARKOV

Data Field	Default Value	Description
R_1	55.0	Lag angle for thermal thrust due to Earth heating (deg)*
R_2	30.0	Heating/cooling constant for thermal thrust due to solar heating (minutes)*

* changed only if non-zero

PRIMARY IDENTIFIER: SUBARC

The inputs associated with the primary identifier SUBARC determine the dynamical quantities which will be treated as subarc rather than global parameters. The force model corresponding to the subarc parameter must be activated in FORCES. Each type of subarc parameter has its own subarc length. The secondary identifiers, summarized below, are described in detail on the following pages.

BURN – Specify impulse burn accelerations.

CD – Specify atmospheric drag coefficient c_d and $\dot{c}_d$.

CT – Specify tangential acceleration (empirical drag) coefficient c_t and $\dot{c}_t$.

DENCOR – Specify subarc length for atmospheric density correction.

DENSTY – Specify once/rev atmospheric density correction parameters.

DRAG – Specify subarc length for atmospheric drag coefficients.

DRAGL – Specify subarc length for tangential acceleration coefficients.

DUTEST – Specify subarc length for $\delta(\mathrm{UT1}-\mathrm{TAI})$.

DXPEST – Specify subarc length for δx_p.

DYPEST – Specify subarc length for δy_p.

ETA – Specify solar radiation reflectivity coefficients.

GCNEST – Specify subarc length for geocenter location.

HFPEST – Specify subarc length for high-frequency EOPs (diurnals).

NORMAL – Specify normal component of periodic RTN acceleration.

NUMBRN – Specify number of impulse burns.

RADIAL – Specify radial component of periodic RTN acceleration.

RADPR – Specify subarc length for reflectivity coefficients.

RTNPRT – Specify subarc length for periodic RTN acceleration.

TIDE – Specify subarc length for tides.

TRANSV – Specify transverse component of periodic RTN acceleration.

Primary Identifier: SUBARC

Secondary Identifier: BURN

Format: 10X, A6, I4, 3E20.13

Purpose: Specify impulse accelerations for each burn that is being estimated.

Data Field	Default Value	Description
I_1		Burn number (between 0 and 50)
R_1	0.0	Acceleration magnitude (10^{-9} m/sec^2) for I_1th burn

Note: If I_1 is 0, all burns will be initialized using R_1.

Primary Identifier: SUBARC

Secondary Identifier: CD

Format: 10X, A6, I4, 3E20.13

Purpose: Specify impulse accelerations for each burn that is being estimated.

Data Field	Default Value	Description
I_1		Subarc indicator (between 0 and 200).
R_1	0.0	c_d for I_1th subarc.
R_2	0.0	$\dot{c}_d$ for the I_1th subarc.

Note: If I_1 is 0, all subarcs will be initialized using R_1 and R_2.

Primary Identifier: SUBARC

Secondary Identifier: CT

Format: 10X, A6, I4, 3E20.13

Purpose: Specify tangential acceleration (empirical drag) coefficients c_t and $\dot{c}_t$ for each subarc.

Data Field	Default Value	Description
I_1		Subarc indicator (between 0 and 300).
R_1	0.0	c_t for $I_1 th$ subarc (10^{-12} m/sec^2).
R_2	0.0	$\dot{c}_t$ for $I_1 th$ subarc (10^{-12} m/sec^2).

Note: If I_1 is 0, all subarcs will be initialized using R_1 and R_2.

Primary Identifier: SUBARC

Secondary Identifier: DENCOR

Format: 10X, A6, I4, 3E20.13

Purpose: Specify once/rev density correction coefficients c and s for each subarc.

Data Field	Default Value	Description
I_1		Subarc indicator (between 0 and 20).
R_1	0.0	c for $I_1 th$ subarc.
R_2	0.0	s for $I_1 th$ subarc.

Note: If I_1 is 0, all subarcs will be initialized using R_1 and R_2.

Primary Identifier: SUBARC

Secondary Identifier: DENSTY

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for once/rev atmospheric density correction coefficients.

Data Field	Default Value	Description
R_1	0.0	Subarc length in days.

Note: If R_1 is zero or greater than arc length, subarc length = arc length.

Primary Identifier: SUBARC

Secondary Identifier: DRAG

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for atmospheric drag coefficients.

Data Field	Default Value	Description
R_1	0.0	Subarc length in days.

Note: If R_1 is zero or greater than arc length, subarc length = arc length.

Primary Identifier: SUBARC

Secondary Identifier: DRAGL

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for tangential acceleration coefficients.

Data Field	Default Value	Description
R_1	0.0	Subarc length in days.

Note: If R_1 is zero or greater than arc length, subarc length = arc length.

Primary Identifier: SUBARC

Secondary Identifier: DUTEST

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for $\delta(\mathrm{UT1} - TAI)$

Data Field	Default Value	Description
R_1	0.0	Subarc length of first subarc in days.
R_2	0.0	Subarc length of remaining subarc in days.

Notes:

(1) All subarcs after the first will be set to the same length specified by R_2.

(2) Maximum number of subarcs allowed per arc is 60.

Primary Identifier: SUBARC

Secondary Identifier: DXPEST

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for δx_p

Data Field	Default Value	Description
R_1	0.0	Subarc length in days.

Notes:

(1) All subarcs will be initialized with the same value specified in SOLVEPARAM − DXPEST.

(2) Subarc length for DXPEST and DYPEST should be same.

(3) Maximum number of subarcs allowed per arc is 60.

Primary Identifier: SUBARC

Secondary Identifier: DYPEST

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for δy_p

Data Field	Default Value	Description
R_1	0.0	Subarc length in days.

Notes:

(1) All subarcs will be initialized with the same value specified in SOLVEPARAM − DXPEST.

(2) Subarc length for DXPEST and DYPEST should be same.

(3) Maximum number of subarcs allowed per arc is 60.

Primary Identifier: SUBARC

Secondary Identifier: ETA

Format: 10X, A6, I4, 3E20.13

Purpose: Specify solar radiation reflectivity for each subarc.

Data Field	Default Value	Description
I_1		Subarc indicator (between 0 and 30)
R_1	0.0	For $I_1 th$ subarc.
R_2	0.0	For $I_1 th$ subarc.

Note: If I_1 is 0, all subarcs will be initialized using R_1 and R_2.

Primary Identifier: SUBARC

Secondary Identifier: GCNEST

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for geocenter location.

Data Field	Default Value	Description
R_1	0.0	Subarc length in days.

Primary Identifier: SUBARC

Secondary Identifier: HFPEST

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for high-frequency EOPs (diurnal and semidiurnal EOPs).

Data Field	Default Value	Description
R_1	0.0	Subarc length in days.

Primary Identifier: SUBARC

Secondary Identifier: NORMAL

Format: 10X, A6, I4, 3E20.13

Purpose: Specify periodic RTN coefficients c_{nor} and s_{nor} for each subarc.

Data Field	Default Value	Description
I_1		Subarc indicator (between 0 and 60).
R_1	0.0	c_{nor} for $I_1 th$ subarc (10^{-9} m/sec^2).
R_2	0.0	s_{nor} for $I_1 th$ subarc (10^{-9} m/sec^2).

Note: If I_1 is 0, all subarcs will be initialized using R_1 and R_2.

Primary Identifier: SUBARC

Secondary Identifier: NUMBRN

Format: 10X, A6, I4, 3E20.13

Purpose: Specify number of burns.

Data Field	Default Value	Description
I_1	1	Number of burns in the arc (between 0 and 50)

Primary Identifier: SUBARC

Secondary Identifier: RADIAL

Format: 10X, A6, I4, 3E20.13

Purpose: Specify periodic RTN coefficients c_{rad} and s_{rad} for each subarc.

Data Field	Default Value	Description
I_1		Subarc indicator (between 0 and 60).
R_1	0.0	c_{rad} for $I_1 th$ subarc (10^{-9} m/sec^2).
R_2	0.0	s_{rad} for $I_1 th$ subarc (10^{-9} m/sec^2).

Note: If I_1 is 0, all subarcs will be initialized using R_1 and R_2.

Primary Identifier: SUBARC

Secondary Identifier: RADPR

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for solar radiation reflectivity coefficients.

Data Field	Default Value	Description
R_1	0.0	Subarc length in days.

Note: If R_1 is zero or greater than arc length, subarc length = arc length.

Primary Identifier: SUBARC

Secondary Identifier: RTNPRT

Format: 10X, A6, I4, 3E20.13

Purpose: Specify subarc length for periodic RTN coefficients.

Data Field	Default Value	Description
R_1	0.0	Subarc length in days.

Note: If R_1 is zero or greater than arc length, subarc length = arc length.

Primary Identifier: SUBARC

Secondary Identifier: TIDE

Format: 10X, A6, I4, 3E20.13

Purpose: Set subarc tide arc length.

Data Field	Default Value	Description
R_1	0	Subarc length in days.

Primary Identifier: SUBARC

Secondary Identifier: TRANSV

Format: 10X, A6, I4, 3E20.13

Purpose: Specify periodic RTN coefficients c_{tra} and s_{tra} for each subarc.

Data Field	Default Value	Description
I_1		Subarc indicator (between 0 and 60).
R_1	0.0	c_{tra} for $I_1 th$ subarc (10^{-9} m/sec^2).
R_2	0.0	s_{tra} for $I_1 th$ subarc (10^{-9} m/sec^2).

Note: If I_1 is 0, all subarcs will be initialized using R_1 and R_2.

PRIMARY IDENTIFIER: STA/OBS

The inputs associated with STA/OBS specify the type of measurements to process (or simulate), editing criteria and tracking station network. Also, various corrections to the observations can be activated or deactivated. One important point is that a tracking station name must be set before any card referring to that station appears (e.g., ACT, DEACT, CHORD, SURVEY, BIAS, OBS, LAMBDA). The secondary identifiers, summarized below, are described in detail on the following pages.

ABIAS − Specify altimeter bias, time bias and scale factor for H1/3 correction.

ACT − Activate specified station.

AE − Specify equatorial radius of the reference ellipsoid for tracking stations.

AGCEDT − Activate editing of altimeter or crossovers according to AGC.

ALIAS − Specify aliases.

ALPHA − Specify refraction scale parameters.

ALTBND − Specify latitude and longitude bounds for altimeter measurements.

BARYCN − Specify reference frame for light time solutions.

BEA − Specify equatorial radius of the reference ellipsoid for altimeter.

BIAS − Specify measurement biases by station.

CHORDP − Suppress printing of station chords.

CLIGHT − Specify speed of light to use in measurement model.

CMOFF1 − Activate satellite center of mass offset correction to range.

CMOFF2 − Activate center of mass offset correction to two-way range rate.

CMOFF3 − Activate center of mass offset correction to one-way range rate.

CMOFF4 − Activate center of mass offset correction to biased range rate.

CMOFFA − Activate constant center of mass offset correction to altimeter.

DEACT − Deactivate specified station.

DTALT − Specify time interval between simulated altimeter measurements.

ECCEN − Specify station eccentricities.

ECCEN2 − Specify station wavelength updates.

ECCPRN − Suppress station eccentricities printout.

ECCUPD – Suppress application of bias and/or time bias via eccentricity cards.

EDCRIT – Specify measurement editing criteria.

EDIT – Activate residual editing.

EDIT1 – Activate first-level editing.

EDIT2 – Activate second-level editing.

EDITX – Specify editing criteria for trajectory fit (MEASX) runs.

EDTBRN – Activate editing window around burn.

ELMIN – Specify minimum elevation for simulating or processing observations.

GEOIDC – Activate geoid correction to altimeter measurements.

GFLAT – Specify reciprocal flattening of the reference ellipsoid for altimeter.

GLAG – Specify lag angle for geometric solid earth tide.

GTIDES – Activate geometric solid earth tide and specify Love numbers.

H13EDT – Activate editing of altimeter or crossovers according to $H_{1/3}$.

HOURS – Specify tracking shift times (local time) for each station.

INVBAR – Activate inverted barometer correction to altimeter.

LAMBDA – Specify laser wavelength by station.

MEAS1 – Activate range measurements.

MEAS2 – Activate two-way range-rate measurements.

MEAS3 – Activate azimuth measurements.

MEAS4 – Activate elevation measurements.

MEAS5 – Activate altimeter measurements.

MEAS6 – Activate altimeter crossover measurements.

MEAS7 – Activate one-way range-rate measurements.

MEAS9 – Activate one-way biased range measurements.

MEASX – Activate trajectory generation, comparison and fitting.

NOLAND – Activate editing land points when processing altimeter measurements.

PASSDT – Specify time gap defining a new pass for pass-dependent parameters.

PLAMOT – Activate tectonic plate motion model and set epoch.

PLANEW – Assign a station to a particular tectonic plate.

PLAPRN – Plate motion model information print control.

PLAVEL – Set tectonic plate angular velocities.

REFRAC – Activate atmospheric refraction corrections.

REFRC1 – Specify troposphere mapping function.

REFRC2 – Use external zenith wet troposphere delay.

RELCOR – Activate relativistic light time correction.

RFLAT – Specify reciprocal flattening of the reference ellipsoid for tracking stations.

RTIDES – Activate relativistic station location corrections.

SATFRQ – Specify frequencies and antenna pattern for ionosphere refraction model.

SEED – Specify random number generator seed for simulated measurement noise.

SIGMA – Specify measurement standard deviation by station.

SSTCOR – Activate sea surface topography correction for altimeter.

SSTSUB – Specify substitute coefficients for sea surface topography model.

STAPRN – Station information print control.

STAVEL – Specify individual site velocities.

SURVEY – Specify survey values of tracking station coordinates.

SYSTEM – Specify coordinate system for input or output trajectory files.

TIDEC – Activate ocean tide correction to altimeter measurements.

T1T2 – Specify time bounds for simulated measurements.

WEIGHT – Specify weighting parameters.

WTNODE – Specify linearly interpolated network weighting function.

<name> – Specify tracking station literal <name>, ID number and coordinates.

Primary Identifier: STA/OBS

Secondary Identifier: ABIAS

Format: 10X, A6, I4, 4E15.7

Purpose: Set the observation bias, time bias, and significant wave height (H1/3) correction scale factor for altimeter measurements.

Data Field	Default Value	Description
R_1	0.0	Altimeter bias (m).
R_2	0.0	Altimeter time bias (milliseconds).
R_3	0.0	Scale factor for H1/3 correction.

Primary Identifier: STA/OBS

Secondary Identifier: ACT

Format: 10X, A6, I4, 4E15.7

Purpose: Activate station whose ID is given.

Data Field	Default Value	Description
I_1		Observing station ID number.

Notes: 1) This identifier is used to negate a DEACT identifier.

2) If the station ID is 0, all stations currently set in the tracking station array will be activated.

Primary Identifier: STA/OBS

Secondary Identifier: AE

Format: 10X, A6, I4, 4E15.7

Purpose: Equatorial radius of the earth for tracking station network.

Data Field	Default Value	Description
R_1	6378137.	Equatorial radius in meters (changed only if non-zero).

Primary Identifier: STA/OBS

Secondary Identifier: AGCEDT

Format: 10X, A6, I4, 4E15.7

Purpose: Activate editing altimeter or altimeter crossovers according to automatic gain control (AGC).

Data Field	Default Value	Description
I_1	0	AGC editing control: If = 0, do not edit. If = 1, edit.
R_1	0.0	Minimum allowable value for AGC (db) when editing.
R_2	99.0	Maximum allowable value for AGC (db) when editing.

Primary Identifier: STA/OBS

Secondary Identifier: ALIAS

Format: 10X, A6, I4, 4E15.7

Purpose: Specify station identifier aliases.

Data Field	Default Value	Description
I_1	0	Station identification number which requires alias.
R_1	0	Alias for station specified by I_1, i.e., data with station identifier I_1 will be treated as if it were actually data from station identified by INT (R_1).

Primary Identifier: STA/OBS

Secondary Identifier: ALPHA

Format: 10X, A6, I4, 4E15.7

Purpose: Specify refraction scaling factors for ground-based tracking station.

Data Field	Default Value	Description
I_1	0	Tracking station ID number.
R_1	1.0	Tropospheric refraction scale factor.
R_2	0.0	Ionospheric refraction scale factor.

Primary Identifier: STA/OBS

Secondary Identifier: ALTBND

Format: 10X, A6, I4, 4E15.7

Purpose: Latitude and longitude bounds for accepting altimeter observations.

Data Field	Default Value	Description
I_1	0	Altimeter edit flag. If = 0, do not edit points outside specified bounds. If = 1, edit points outside specified bounds.
R_1	0.0	Minimum longitude accepted (deg).
R_2	360.0	Maximum longitude accepted (deg).
R_3	−90.0	Minimum geodetic latitude accepted (deg).
R_4	+90.0	Maximum geodetic latitude accepted (deg).

Primary Identifier: STA/OBS

Secondary Identifier: BARYCN

Format: 10X, A6, I4, 4E15.7

Purpose: Specify reference frame for light time computations.

Data Field	Default Value	Description
I_1	0	Reference frame indicator. If = 0, use geocentric light time solutions. If = 1, use solar-system barycentric light time solutions.

Primary Identifier: STA/OBS

Secondary Identifier: BEA

Format: 10X, A6, I4, 4E15.7

Purpose: Equatorial radius of reference ellipsoid for altimeter observations.

Data Field	Default Value	Description
R_1	6378137.0	Equatorial radius in meters (changed only if non-zero).

Primary Identifier: STA/OBS

Secondary Identifier: BIAS

Format: 10X, A6, I4, 4E15.7

Purpose: Set observation bias and timing bias for observations taken by station whose ID is given.

Data Field	Default Value	Description
I_1		Station ID number.
R_1	0.0	Observation bias (m, cm/sec or arcsec).
R_2	0.0	Timing bias (millisec).
R_3	0.0	Observation bias drift (m/sec, cm/sec/sec).

Note: If the station ID is 0, the observation bias for all stations currently set in the tracking station array will be set to R_1.

Primary Identifier: STA/OBS

Secondary Identifier: CHORDP

Format: 10X, A6, I4, 4E15.7

Purpose: Station chord length print control.

Data Field	Default Value	Description
I_1	1	Chord print control flag. If = 0, do not print station chord lengths. If = 1, print station chord lengths.

Primary Identifier: STA/OBS

Secondary Identifier: CLIGHT

Format: 10X, A6, I4, 4E15.7

Purpose: Set the speed of light to use in measurement model. Input observations will be scaled to be compatible with the specified speed of light, and simulated observations will be computed using the specified speed of light.

Data Field	Default Value	Description
I_1	1	Speed of light control flag. If = 0, c = 299792500. m/sec . If = 1, c = 299792458. m/sec .

Primary Identifier: STA/OBS

Secondary Identifier: CMOFF1

Format: 10X, A6, I4, 4E15.7

Purpose: Activate correction to laser range observations for center-of-mass offset.

Data Field	Default Value	Description
I_1	0	Correction switch: If = 0, make no correction. If = 1, use constant offset as given by R_1 (m). If = 2, use simple cosine model given by $R_1 \cos(\phi - R_2^{\circ})$ where ϕ is the angle between the line of sight and the gravity gradient stabilized satellite major axis (R_1 in meters and R_2 in degrees). If = 3, reflector offset given in satellite-centered coordinates (R_1, R_2, R_3) (in meters). If = 4, use GEOS-C model. If = 5, use SEASAT-A model. If = 6, use GEOS-B model. If = 7, use BE-C model. If = 8, use DE-C model. If = 9, use PEOLE model.
R_1 through R_3	0.0	As described above.

Note: For ERS-1 (SATID = 9105001), an additional phase center correction of 4.3 cm is automatically included.

Primary Identifier: STA/OBS

Secondary Identifier: CMOFF2

Format: 10X, A6, I4, 4E15.7

Purpose: Activate correction to two-way range rate observations for center-of-mass offset.

Data Field	Default Value	Description
I_1	0	Correction switch: If = 0, make no correction. If = 1, use constant offset as given by R_1 (m). If = 2, use simple cosine model given by $R_1 \cos(\phi - R_2^{\circ})$ where ϕ is the angle between the line of sight and the gravity gradient stabilized satellite major axis (R_1 in meters and R_2 in degrees). If = 3, antenna offset given in satellite-centered coordinates (R_1, R_2, R_3) (in meters).
R_1 through R_3	0.0	As described above.

Primary Identifier: STA/OBS

Secondary Identifier: CMOFF3

Format: 10X, A6, I4, 4E15.7

Purpose: Activate correction to one-way range rate observations for center-of-mass offset.

Data Field	Default Value	Description
I_1	0	Correction switch: If = 0, make no correction. If = 1, use constant offset as given by R_1 (m). If = 2, use simple cosine model given by $R_1 \cos(\phi - R_2^{\circ})$ where ϕ is the angle between the line of sight and the gravity gradient stabilized satellite major axis (R_1 in meters and R_2 in degrees). If = 3, antenna offset given in satellite-centered coordinates (R_1, R_2, R_3) (in meters).
R_1 through R_3	0.0	As described above.

Primary Identifier: STA/OBS

Secondary Identifier: CMOFF4

Format: 10X, A6, I4, 4E15.7

Purpose: Activate correction to biased range observations for center-of-mass offset.

Data Field	Default Value	Description
I_1	0	Correction switch: If = 0, make no correction. If = 1, use constant offset as given by R_1 (m). If = 2, use simple cosine model given by $R_1 \cos(\phi - R_2^{\circ})$ where ϕ is the angle between the line of sight and the gravity gradient stabilized satellite major axis (R_1 in meters and R_2 in degrees). If = 3, antenna offset given in satellite-centered coordinates (R_1, R_2, R_3) (in meters).
R_1 through R_3	0.0	As described above.

Primary Identifier: STA/OBS

Secondary Identifier: CMOFFA

Format: 10X, A6, I4, 4E15.7

Purpose: Set center-of-mass offset correction to be made to altimeter observations if not already applied.

Data Field	Default Value	Description
R_1	0.0	Constant correction to be used (m).

Primary Identifier: STA/OBS

Secondary Identifier: DEACT

Format: 10X, A6, I4, 4E15.7

Purpose: Deactivate station whose ID is given.

Data Field	Default Value	Description
I_1		Observing station ID number.

Note: If the station ID is 0, all stations currently set in the tracking station array will be deactivated.

Primary Identifier: STA/OBS

Secondary Identifier: DTALT

Format: 10X, A6, I4, 4E15.7

Purpose: Time interval between simulated altimeter observations (other observation types use DTPASS as interval between observations).

Data Field	Default Value	Description
R_1		Time interval in seconds.

Primary Identifier: STA/OBS

Secondary Identifier: ECCEN

Format: 10X, A6, I4, 4E15.7

Purpose: Specify station eccentricities (marker to reference point).

Data Field	Default Value	Description
R_1	0.0	Effective date of eccentricity.
R_2	0.0	East component (m).
R_3	0.0	North component (m).
R_4	0.0	Vertical component (m).

Primary Identifier: STA/OBS

Secondary Identifier: ECCEN2

Format: 10X, A6, I4, 4E15.7

Purpose: Specify additional station parameters to be updated.

Data Field	Default Value	Description
R_1	0.0	New value of station wavelength (angstroms) (effective date given by previous ECCEN card)
R_2	0.0	New value of measurement bias (m, cm/sec or arcsec).
R_3	0.0	New value of timing bias (millisec).
R_4	previous	New value of station sigma (m, cm/sec, or arcsec) (changed only if non-zero).

Note: The ECCEN2 card for a station must immediately follow the appropriate ECCEN card.

Primary Identifier: STA/OBS

Secondary Identifier: ECCPRN

Format: 10X, A6, I4, 4E15.7

Purpose: Suppress station eccentricities printout.

Data Field	Default Value	Description
I_1	0	If = 0, suppress station eccentricity information. If = 1, print full station eccentricity information.

Primary Identifier: STA/OBS

Secondary Identifier: ECCUPD

Format: 10X, A6, I4, 4E15.7

Purpose: Suppress the application of updates to the bias and/or time bias for stations which are specified on the eccentricity cards.

Data Field	Default Value	Description
I_1	0	Eccentricity update flag If = 0, update bias and time bias as specified on eccentricity cards. If = 1, do not update bias. If = 2, do not update time bias. If = 3, do not update bias or time bias.

Primary Identifier: STA/OBS

Secondary Identifier: EDCRIT

Format: 10X, A6, I4, 4E15.7

Purpose: Observation editing criteria can be fixed or can change according to RMS of residuals.

Data Field	Default Value	Description	
I_1		*Observation type*	*Units*
		1 = range	m
		2 = two-way range-rate	cm/sec
		3 = azimuth	arcsec
		4 = elevation	arcsec
		5 = altimeter	m
		6 = altimeter crossover	m
		7 = one-way range-rate	cm/sec
		9 = biased range	m
R_1	1000.0	Initial and maximum edit criteria for each arc (changed only if non-zero).	
R_2	0.0	Minimum edit criteria when editing is keyed to RMS (when $R_1 = R_2$, edit criteria is fixed).	
R_3	3.0	Level of editing if automatic edit is on; i.e., after each pass through data, edit criteria is set to R_3 times residual RMS (changed only if non-zero).	

Primary Identifier: STA/OBS

Secondary Identifier: EDIT

Format: 10X, A6, I4, 4E15.7

Purpose: Residual editing control.

Data Field	Default Value	Description
I_1	0	Residual editing control: If = 0, observations are processed regardless of the magnitude of the residual. If = 1, observations are not processed if the magnitude of the residual exceeds user input limits (specified by EDCRIT card).

Primary Identifier: STA/OBS

Secondary Identifier: EDIT1

Format: 10X, A6, I4, 4E15.7

Purpose: Activate checking edit flag previously set by UTOPIA or by pre-processing programs.

Data Field	Default Value	Description
I_1	0	First-level edit control: If = 0, process observations even if the first-level flag is set. If = 1, compute residuals but do not process observations where the first-level flag is set. If = 2, do not compute residuals or process observations where the first-level edit flag is set (flagged points will not be included in residual file).

Primary Identifier: STA/OBS

Secondary Identifier: EDIT2

Format: 10X, A6, I4, 4E15.7

Purpose: Activate checking edit flag set by EDTLSQ or other post-processing programs.

Data Field	Default Value	Description
I_1	0	Second level edit control: If = 0, process observations even if the second level flag is set. If = 1, compute residuals but do not process observations where the second level edit flag is set. If = 2, do not compute residuals or process observations where the second level edit flag is set (flagged points will not be included in the residual file).

Primary Identifier: STA/OBS

Secondary Identifier: EDITX

Format: 10X, A6, I4, 4E15.7

Purpose: Specify editing criteria for trajectory fit (MEASX) runs.

Data Field	Default Value	Description
R_1	1.E10	Editing criteria for differences in the radial direction (changed only if non-zero).
R_2	1.E10	Editing criteria for differences in the transverse direction (changed only if non-zero).
R_3	1.E10	Editing criteria for differences in the normal direction (changed only if non-zero).

Primary Identifier: STA/OBS

Secondary Identifier: EDTBRN

Format: 10X, A6, I4, 4E15.7

Purpose: To activate editing observations in a time interval (window) around an impulsive maneuver.

Data Field	Default Value	Description
I_1	0	Burn edit flag If = 0, do not edit observations around burns. If = 99, edit all observations around burns. If = iobs, edit observation type iobs around burns ($0 < iobs < 99$).
R_1	0.0	Edit window size (in seconds). All observations in a ± window of burn will be edited.

Primary Identifier: STA/OBS

Secondary Identifier: ELMIN

Format: 10X, A6, I4, 4E15.7

Purpose: Minimum elevation angle to be allowed when simulating or processing ground-based observations.

Data Field	Default Value	Description
I_1	0	Elevation edit flag. If = 0, do not edit observations according to elevation angle. If = 1, edit observations which are below minimum elevation angle.
R_1	20.0	Minimum allowable elevation angle (deg).

Note: I_1 has no effect in MODE 5—the minimum elevation angle is always used to determine satellite visibility.

Primary Identifier: STA/OBS

Secondary Identifier: GEOIDC

Format: 10X, A6, I4, 4E15.7

Purpose: Control geoid correction to altimeter observations.

Data Field	Default Value	Description
I_1	0	Geoid correction control switch: If = -1, make no correction.* If = 0, apply correction as packed in observation format. If = 1, correct using external geoid file (file GEOID required).* If = 2, correct using computed geoid based on geopotential.*
R_1	6263686.0	Value of equipotential surface corresponding to geoid (m^2/sec^2).
R_2	0.01	Convergence criteria for geoid computation (m^2/sec^2).
R_3	3	Maximum allowable iterations for geoid computation.

* Remove existing correction if already applied.

Primary Identifier: STA/OBS

Secondary Identifier: GFLAT

Format: 10X, A6, I4, 4E15.7

Purpose: Reciprocal of the flattening of the reference ellipsoid for altimeter observations.

Data Field	Default Value	Description
R_1	298.257	Reciprocal of flattening (1/f) (changed only if non-zero).

Primary Identifier: STA/OBS

Secondary Identifier: GLAG

Format: 10X, A6, I4, 4E15.7

Purpose: Input the lag angle (in degrees) for geometric solid earth tidal variations in station coordinates.

Data Field	Default Value	Description
R_1	0.0	The lag angle for geometric lunar tidal variations in station coordinates.
R_2	0.0	The lag angle for geometric solar tidal variations in station coordinates.

Primary Identifier: STA/OBS

Secondary Identifier: GTIDES

Format: 10X, A6, I4, 4E15.7

Purpose: Activate geometric solid earth tides and set Love numbers.

Data Field	Default Value	Description
I_1	0	Set geometric solid earth tide identifiers: If = 0, exclude from observation geometry. If = 1, include in observation geometry.
R_1	0.609	First Love number, h_2 (changed only if non-zero).
R_2	0.0852	Second Love number, l_2 (changed only if non-zero).

Primary Identifier: STA/OBS

Secondary Identifier: H13EDT

Format: 10X, A6, I4, 4E15.7

Purpose: Activate editing altimeter or altimeter crossovers according to significant wave height (H1/3).

Data Field	Default Value	Description
I_1	0	H1/3 editing control: If = 0, do not edit. If = 1, edit.
R_1	0.0	Minimum allowable value for H1/3 (m) when editing.
R_2	99.0	Maximum allowable value for H1/3 (m) when editing.

Primary Identifier: STA/OBS

Secondary Identifier: HOURS

Format: 10X, A6, I4, 4E15.7

Purpose: Specify tracking shift times (local time) for each station during simulation.

Data Field	Default Value	Description
I_1		Station ID
R_1	0.0	Local time to start tracking shift (hours).
R_2	24.0	Local time to stop tracking shift (hours).

Primary Identifier: STA/OBS

Secondary Identifier: INVBAR

Format: 10X, A6, I4, 4E15.7

Purpose: Activate inverted barometer correction for altimeter.

Data Field	Default Value	Description
I_1	0	Inverted barometer correction: If = 0, do not apply. If = 1, apply.
R_1	−.009948	Inverse barometer scale factor (m/mbar).
R_2	1010.6	Reference pressure (mbar).

Note: Correction model is R_1 * (pressure − R_2).

Primary Identifier: STA/OBS

Secondary Identifier: LAMBDA

Format: 10X, A6, I4, 4E15.7

Purpose: Set wavelength of tracking stations with laser ranging.

Data Field	Default Value	Description
I_1		Station ID.
R_1	6943.0	Laser wavelengths (*angstroms*).

Note: If the station ID is 0, the observation lambda for all stations currently set in the tracking station array will be set to R_1.

Primary Identifier: STA/OBS

Secondary Identifier: MEAS1

Format: 10X, A6, I4, 4E15.7

Purpose: Include range measurements and specify range model (alternate identifier: RANGE).

Data Field	Default Value	Description
I_1	0	Range observation switch: If = 0, do not include range. If = 1, include laser range measurement using instantaneous range model. If = 2, include laser range measurement using light time solution range model.

Primary Identifier: STA/OBS

Secondary Identifier: MEAS2

Format: 10X, A6, I4, 4E15.7

Purpose: Include two-way range-rate measurements and specify range-rate model (alternate identifier: 2WAYRR).

Data Field	Default Value	Description
I_1	0	Two-way range-rate observation switch: If = 0, do not include range-rate. If = 1, include range-rate measurement using average range-rate model with light time solution.
R_1	1.0	Count interval to use when simulating range-rate (changed only if non-zero).
R_2	1.0	Minimum count interval (sec) to accept when processing range-rate observations.
R_3	180.0	Maximum count interval to accept when processing range-rate observations (changed only if non-zero).

Note: See also MEAS7

Primary Identifier: STA/OBS

Secondary Identifier: MEAS3

Format: 10X, A6, I4, 4E15.7

Purpose: Include or exclude azimuth observations (alternate identifier: AZ).

Data Field	Default Value	Description
I_1	0	Azimuth observation switch: If = 0, do not include. If = 1, include.

Primary Identifier: STA/OBS

Secondary Identifier: MEAS4

Format: 10X, A6, I4, 4E15.7

Purpose: Include or exclude elevation observations (alternate identifier: EL).

Data Field	Default Value	Description
I_1	0	Elevation observation switch: If = 0, do not include. If = 1, include.

Primary Identifier: STA/OBS

Secondary Identifier: MEAS5

Format: 10X, A6, I4, 4E15.7

Purpose: Include or exclude altimeter observations and set altimeter standard deviation (alternate identifier: ALTIM).

Data Field	Default Value	Description
I_1	0	Altimeter observation switch: If = 0, do not include. If = 1, include. If = 2, include but do not include altimeter data in estimation of time bias or EM bias.
R_1	1.0	Altimeter observation standard deviation (m).

Primary Identifier: STA/OBS

Secondary Identifier: MEAS6

Format: 10X, A6, I4, 4E15.7

Purpose: Include or exclude altimeter crossover observations and set altimeter crossover standard deviation (alternate identifier: ALTCX).

Data Field	Default Value	Description
I_1	0	Altimeter crossover observation switch: If = 0, do not include. If = 1, include.
R_1	1.0	Altimeter crossover observation standard deviation (m).
R_2	0.0	If non-zero, use special TOPEX crossover weighting factor.

Primary Identifier: STA/OBS

Secondary Identifier: MEAS7

Format: 10X, A6, I4, 4E15.7

Purpose: Include one-way range-rate measurements and specify range-rate model (alternate identifier: 1WAYRR).

Data Field	Default Value	Description
I_1	0	One-way range-rate observation switch: If = 0, do not include range-rate. If = 1, include range-rate measurement using average range-rate model with light time solution.
R_1	1.0	Count interval to use when simulating range-rate (changed only if non-zero).
R_2	1.0	Minimum count interval (sec) to accept when processing range-rate observations.
R_3	180.0	Maximum count interval to accept when processing range-rate observations (changed only if non-zero).
R_4	1	If = 1, create simulated DORIS (1-way) or PRARE (2-way) data rather than TRANET (1-way) or S-Band (2-way) data.

Primary Identifier: STA/OBS

Secondary Identifier: MEAS9

Format: 10X, A6, I4, 4E15.7

Purpose: Include one-way biased range measurements (alternate identifier: BSDRNG).

Data Field	Default Value	Description
I_1	0	One-way biased range observation switch: If = 0, do not include biased range. If = 1, include biased range measurement.

Primary Identifier: STA/OBS

Secondary Identifier: MEASX

Format: 10X, A6, I4, 4E15.7

Purpose: Activate trajectory generation, comparison or fitting for MODE 2 and MODE 4. Use SYSTEM card to specify coordinate system to be used.

Data Field	Default Value	Description
I_1	0	MODE 2: If = 0, do not generate a trajectory file. If = 1, generate a trajectory file on STATE. If = 2, generate a trajectory file on STATE and compare to user-supplied trajectory on OBSDAT. MODE 4: If = 0, observation file OBSDAT is not a trajectory file. If = 1, OBSDAT is a trajectory file; process position components only. If = 2, OBSDAT is a trajectory file; process position and velocity components . If = 3, OBSDAT is a trajectory file; process velocity components only. If = 4, OBSDAT is a trajectory file; process RTN components.
R_1	1.0	Standard deviation for position (m) or radial component (m).*
R_2	1.0	Standard deviation for velocity (m/sec) or transverse component (m).*
R_3	1.0	Standard deviation for normal component (m).*

* Used only in MODE 4 and changed only if non-zero.

Primary Identifier: STA/OBS

Secondary Identifier: NOLAND

Format: 10X, A6, I4, 4E15.7

Purpose: Activate editing of altimeter points which have been flagged as being over land.

Data Field	Default Value	Description
I_1	0	Land editing parameter: If = 0, do not edit points over land. If = 1, edit points over land.

Primary Identifier: STA/OBS

Secondary Identifier: PASSDT

Format: 10X, A6, I4, 4E15.7

Purpose: Define time gap between observations from a station which defines the start of a new pass for pass-dependent parameters.

Data Field	Default Value	Description
I_1	0	If = 0, start of new pass defined by R_1. If = 1, start of new pass defined by flag on data. If = 2, start of new pass defined by either R_1 or flag on data.
R_1	1/6 * orbit period	Time gap in seconds

Primary Identifier: STA/OBS

Secondary Identifier: PLAMOT

Format: 10X, A6, I4, 4E15.7

Purpose: Activate tectonic plate motion model and set the epoch time.

Data Field	Default Value	Description
I_1	0	Plate motion model switch If = 0, model off If = 1, model on
R_1	2445335.5 (1 Jan 83)	Epoch Julian date of the plate motion model (changed only if non-zero)

Primary Identifier: STA/OBS

Secondary Identifier: PLANEW

Format: 10X, A6, I4, 4E15.7

Purpose: Assign a station to a particular tectonic plate.

Data Field	Default Value	Description
I_1		Index from 1 to 50
R_1		Station ID whose plate is to be assigned
R_2		Plate number to which the station is assigned (must be in the range 1 through 12)

Note: A default list of plate assignments already exists in the program. Use this input to add to or change the list.

Default model is Minster and Jordan AM1-2:

Index	Plate Name	Index	Plate Name
1	EURASIA	7	ANTARC
2	NAMRCA	8	ARABIA
3	INDAUS	9	CARIBN
4	PACIFIC	10	COCOS
5	AFRICA	11	NAZCA
6	SAMCRA	12	NOPLATE

Primary Identifier: STA/OBS

Secondary Identifier: PLAPRN

Format: 10X, A6, I4, 4E15.7

Purpose: Plate motion model print control.

Related Inputs: PLAMOT, PLANEW, PLAVEL, STAVEL

Data Field	Default Value	Description
I_1	0	Plate motion print control flag: If = 0, reduced plate motion model printouts. If = 1, full plate motion model printouts.

Primary Identifier: STA/OBS

Secondary Identifier: PLAVEL

Format: 10X, A6, I4, 4E15.7

Purpose: Set the angular velocities of a tectonic plate.

Data Field	Default Value	Description
I_1		Index of plate whose angular velocity is to be assigned (limited to 1 through 12)
R_1	*	x component of angular velocity in mm/yr at earth's surface
R_2	*	y component of angular velocity in mm/yr at earth's surface
32	*	z component of angular velocity in mm/yr at earth's surface

* Default model is Minster and Jordan AM1-2:

Index	Plate Name	Index	Plate Name
1	EURASIA	7	ANTARC
2	NAMRCA	8	ARABIA
3	INDAUS	9	CARIBN
4	PACIFIC	10	COCOS
5	AFRICA	11	NAZCA
6	SAMCRA	12	NOPLATE

Primary Identifier: STA/OBS

Secondary Identifier: REFRAC

Format: 10X, A6, I4, 4E15.7

Purpose: Include or suppress correction due to tropospheric refraction to range observations, if not already corrected.

Data Field	Default Value	Description
I_1	1	Tropospheric refraction correction switch: If = 0, do not make correction. If = 1, make correction. If = 2, make correction and include correction in output observation file (RESID) If = 3, make correction but remove correction from output observation file (RESID)

The following three real numbers are used only when generating observations to simulate tropospheric refraction:

R_1	999.0	Atmospheric pressure (millibars). Changed only if non-zero.
R_2	293.0	Atmospheric temperature (°K). Changed only if non-zero.
R_3	50.0	Relative humidity (percent). Changed only if non-zero.

Primary Identifier: STA/OBS

Secondary Identifier: REFRC1

Format: 10X, A6, I4, 4E15.7

Purpose: Specify troposphere mapping function used to compute refraction correction for radiometric observations.

Data Field	Default Value	Description
I_1	0	Tropospheric mapping function switch: If = 0, modified Hopfield function. If = 1, Davis mapping function. If = 2, Niell mapping function.

Note: If 1 or 2 is specified, the troposphere scale factors (if estimated) are for the wet troposphere delay only.

Primary Identifier: STA/OBS

Secondary Identifier: REFRC2

Format: 10X, A6, I4, 4E15.7

Purpose: Indicate that an externally determined estimate of the zenith wet troposphere delay is included on the observation card.

Data Field	Default Value	Description
I_1	0	Zenith wet troposphere refraction correction switch: If = 0, zenith wet troposphere delay is computed using modified Saastamoinen model. If = 1, zenith wet troposphere delay is read from observation card.

Note: Option 1 is currently available only for PRARE data. For measurement type 36, the delay is read from columns 67-72. For measurement type 81, the delay is read from columns 67-70.

Primary Identifier: STA/OBS

Secondary Identifier: RELCOR

Format: 10X, A6, I4, 4E15.7

Purpose: Activate relativistic correction to range measurements.

Data Field	Default Value	Description
I_1	0	Relativistic correction flag: If = 0, do not apply correction. If = 1, apply correction.

Note: Model appropriate to reference frame (defined by BARCYN) is used.

Primary Identifier: STA/OBS

Secondary Identifier: RFLAT

Format: 10X, A6, I4, 4E15.7

Purpose: Reciprocal of the flattening of the reference ellipsoid for tracking station.

Data Field	Default Value	Description
R_1	298.257	Reciprocal of flattening (1/f) (changed only if non-zero).

Primary Identifier: STA/OBS

Secondary Identifier: RTIDES

Format: 10X, A6, I4, 4E15.7

Purpose: Activate the relativistic station coordinate correction.

Data Field	Default Value	Description
I_1	0	Relativistic station coordinate correction flag: If = 0, do not apply correction. If = 1, apply correction.

Primary Identifier: STA/OBS

Secondary Identifier: SATFRQ

Format: 10X, A6, I4, 4E15.7

Purpose: Set frequencies and antenna pattern for use in ionospheric refraction model.

Data Field	Default Value	Description
I_1	2	Antenna pattern model If = 1, NAVSAT If = 2, NOVA If = 3, wide band
R_1	400.0	High frequency for two-frequency doppler
R_2	150.0	Low frequency for two-frequency doppler
R_3	2000.0	Frequency for single-frequency doppler

Primary Identifier: STA/OBS

Secondary Identifier: SEED

Format: 10X, A6, I4, 4E15.7

Purpose: A seed for the random number generator used in generating noise for simulated observations.

Data Field	Default Value	Description
R_1	0	Seed for random number generator.

Primary Identifier: STA/OBS

Secondary Identifier: SIGMA

Format: 10X, A6, I4, 4E15.7

Purpose: Set the measurement standard deviation (σ) for a given tracking station.

Data Field	Default Value	Description
I_1		Station ID.
R_1	1.0	Observation σ (m, cm/sec or arcsec).

Note: If the station ID is 0, the observation sigma for all stations currently set in the tracking station array will be set to R_1.

Primary Identifier: STA/OBS

Secondary Identifier: SSTCOR

Format: 10X, A6, I4, 4E15.7

Purpose: Activate quasi-stationary sea surface topography correction for altimeter measurements using the file SST (tape 18).

Data Field	Default Value	Description
I_1	0	Switch If = 0, no correction. If = 1, apply correction.
R_1	25	Maximum zonal harmonic degree
R_2	25	Maximum sectorial and tesseral degree
R_3	25	Maximum sectorial and tesseral order

Primary Identifier: STA/OBS

Secondary Identifier: SSTSUB

Format: 10X, A6, I4, 4E15.7

Purpose: Specific substitute values for individual SST coefficients.

Data Field	Default Value	Description
I_1	0	Print switch If = 0, do not print coefficient. If = 1, print off.

Note: The presence of this identifier indicates that one or more of the following cards will be used to reset the SST coefficients. Each card must be in the same format as a card in the SST file, and the end is indicated by a blank card. Should the characters ESTIM appear in columns 1-6, that coefficient or pair of coefficients will be estimated as well. See also SSTEST in SOLVEPARAM.

Primary Identifier: STA/OBS

Secondary Identifier: STAPRN

Format: 10X, A6, I4, 4E15.7

Purpose: Station information print control.

Data Field	Default Value	Description
I_1	1	Station information print control flag: If = 0, reduced station information printouts. If = 1, full station information printouts.

Primary Identifier: STA/OBS

Secondary Identifier: STAVEL

Format: 10X, A6, I4, 4E15.7

Purpose: Specify individual site velocities.

Related Inputs: PLAMOT, PLANEW, PLAPRN, PLAVEL

Data Field	Default Value	Description
I_1		Station identifier
R_1	0.0	X-component velocity (mm/yr)
R_2	0.0	Y-component velocity (mm/yr)
R_3	0.0	Z-component velocity (mm/yr)

Notes:

1) Up to 300 velocities may be entered.
2) Overrides site velocity based on plate model.
3) Initialization printout indicates 'SITE' for plate but original plate assignment number is retained for reference.

Primary Identifier: STA/OBS

Secondary Identifier: SURVEY

Format: 10X, A6, I4, 4E15.7

Purpose: Set survey values of the tracking station coordinates whose ID is given.

Data Field	Default Value	Description
I_1		Station ID number.
R_1, R_2, R_3		Tracking station coordinates specified in one of the following ways: 1. Height above reference ellipsoid (m), east longitude (deg), geodetic latitude (deg). 2. Height above reference ellipsoid (m), east longitude (DDDMMSS.SSS), geodetic latitude (DDDMMSS.SSS). 3. Body-fixed cartesian coordinates X,Y,Z (m).

Note: Coordinates input via SURVEY are used only for output of coordinate differences.

Primary Identifier: STA/OBS

Secondary Identifier: SYSTEM

Format: 10X, A6, I4, 4E15.7

Purpose: Specify coordinate system for input or output trajectory files.

Data Field	Default Value	Description
I_1	0	Coordinate system identifier: If = 0, trajectory and orbital elements are in mean of 2000.0 non-rotating coordinates. If = 1, trajectory is in body-fixed coordinates; orbital elements are in mean of 2000.0 system. If = 2, trajectory and orbital elements are in true-of-date non-rotating coordinates. If = 3, trajectory and orbital elements are in mean-of-date non-rotating coordinates. If = 4, trajectory is in Inter-Range Vector system; orbital elements are in mean of 2000.0 system.

Primary Identifier: STA/OBS

Secondary Identifier: TIDEC

Format: 10X, A6, I4, 4E15.7

Purpose: Control ocean tide correction to altimeter observations.

Data Field	Default Value	Description
I_1	0	Tide correction control switch: If = −1, make no correction.* If = 0, apply correction as packed in observation format. If = 1, correct using internal Hendershott tide model.*

* Remove existing correction if already applied.

Primary Identifier: STA/OBS

Secondary Identifier: T1T2

Format: 10X, A6, I4, 4E15.7

Purpose: Time bounds for generating simulated altimeter passes.

Data Field	Default Value	Description
I_1		Pass number (up to 100).
R_1		Time to begin I_1^{th} pass (s) counted from initial time.
R_2		Time to end I_1^{th} pass (s) counted from initial time.

Primary Identifier: STA/OBS

Secondary Identifier: WEIGHT

Format: 10X, A6, I4, 4E15.7

Purpose: Specify weighting parameters.

Data Field	Default Value	Description
I_1	0	Data weighting control If = 0, use input station sigmas. If = 1, use sigma packed in observation.
R_1	0.0	Minimum allowable sigma (m, cm or arcsec)

Primary Identifier: STA/OBS

Secondary Identifier: WTNODE

Format: 10X, A6, I4, 4E15.7

Purpose: Specify *i*th node of linearly interpolated laser ranging network weighting function.

Data Field	Default Value	Description
I_1		*i*th node of linearly interpolated weighting function (limit is 5).
R_1		Modified Julian date of *i*th node.
R_2		Value of standard deviation for *i*th node.

Note: If no nodes are specified, network weighting function is deactivated. If there is only one node, all laser tracking data standard deviations are augmented with R_2 (R_1 is ignored).

Primary Identifier: STA/OBS

Secondary Identifier: <name>

Format: 10X, A6, I4, 4E15.7

Purpose: A 6-character name for use in printout and plots is assigned, and coordinates of the station are set.

Data Field	Default Value	Description
I_2		Tracking station identification number.
R_1, R_2, R_3		Tracking station coordinates specified in one of the following ways: 1. Height above reference ellipsoid (m), east longitude (deg), geodetic latitude (deg). 2. Height above reference ellipsoid (m), east longitude (DDDMMSS.SSS), geodetic latitude (DDDMMSS.SSS). 3. Body-fixed cartesian coordinates X,Y,Z (m).

Note: The program is currently limited to 200 different ground-based tracking stations.

PRIMARY IDENTIFIER: INTEG/OUT

The inputs associated with the primary identifier INTEG/OUT are used to specify the integration and printing parameters. Some inputs have different meanings depending on the mode of execution. TF (or TFDAYS) is the only mandatory input, but it is recommended that NPRINT be specified sufficiently large to avoid excessive output. The secondary identifiers, summarized below, are described in detail on the following pages.

- BATPRN − Specify number of digits to include when printing batch matrices.
- CCMAX − Activate printing of highly correlated parameters.
- DTMAX − Mode dependent meaning, see detailed description.
- DTNEW − Mode dependent meaning, see detailed description.
- DTPASS − Mode dependent meaning, see detailed description.
- ENCKE1 − Specify the mean orbital elements for the Encke reference orbit.
- ENCKE2 − Specify additional mean orbital elements for the Encke reference orbit.
- ENCKE3 − Specify mean rates for reference orbit.
- ENCKE4 − Specify initial position displacement from reference orbit.
- ENCKE5 − Specify initial velocity displacement from reference orbit.
- ERROR − Deactivate selected fatal errors.
- FXSTEP − Specify stepsize and order for fixed-step integrator KSGFS.
- IPARTE − Activate full or partial perturbation evaluation.
- LOCSIG − Activate computation and printing of σ's for local parameters.
- LSTPAS − Specify iteration print control.
- NPRINT − Print frequency control.
- NPTAFT − Continue integration to TF in case an end of file is encountered on the observation file.
- PKPPRN − Specify pass-dependent parameter print control.
- TF − Specify final integration time in seconds.
- TFDAYS − Specify final integration time in days.
- TSTART − Specify time of first output point for MODE 2 or minimum time for first input observation in MODES 3 and 4.

Primary Identifier: INTEG/OUT

Secondary Identifier: BATPRN

Format: 10X, A6, I4, 3E20.13

Purpose: Batch information output control.

Data Field	Default Value	Description
I_1	0	Iteration print control. If = 0, print batch matrices on all iterations. If = 1, print batch matrices only on the last iteration. If = 2, do not print matrices on any iteration.
R_1	0	Number of significant digits to include when printing batch information matrix.
R_2	0	Number of significant digits to include when printing batch covariance matrix.
R_3	0	Number of significant digits to include when printing batch correlation matrix.

Note: If zero digits are requested, then the matrix print out is suppressed. Otherwise, the number of digits requested should be between 4 and 14, inclusive.

Primary Identifier: INTEG/OUT

Secondary Identifier: CCMAX

Format: 10X, A6, I4, 3E20.13

Purpose: Print the names of parameter pairs whose correlation exceeds a specified value.

Data Field	Default Value	Description
R_1	0.0	Minimum correlation coefficient magnitude (used only if non-zero).

Primary Identifier: INTEG/OUT

Secondary Identifier: DTMAX

Format: 10X, A6, I4, 3E20.13

Purpose: The satellite position is checked every DTMAX seconds for visibility by a tracking station. (When the satellite is visible, simulated observations, except altimeter, are generated every DTPASS seconds).

Data Field	Default Value	Description
R_1	1000.	Time interval in seconds.

Primary Identifier: INTEG/OUT

Secondary Identifier: DTNEW

Format: 10X, A6, I4, 3E20.13

Purpose: Meaning is mode dependent.

MODE 2: The interval between output points when predicting or generating a trajectory file.

MODE 3, MODE 4 and MODE 5: The time gap between successive observations that defines a new pass.

Data Field	Default Value	Description
R_1	1800.	Time interval in seconds.

Primary Identifier: INTEG/OUT

Secondary Identifier: DTPASS

Format: 10X, A6, I4, 3E20.13

Purpose: Interval between simulated observations, except when generating altimeter observations.

Data Field	Default Value	Description
R_1	100.0	Time interval in seconds.

Primary Identifier: INTEG/OUT

Secondary Identifier: ENCKE1

Format: 10X, A6, I4, 3E20.13

Purpose: Activate Encke integration and specify the mean orbital elements for the reference orbit.

Data Field	Default Value	Description
I_1		Encke integration control flag If = 0, do not use Encke method. If = 1, use Encke integration with two-body reference orbit. If = 2, use secular precessing ellipse for reference orbit. If = 3, use reference orbit defined by ENCKE1, ENCKE2 and ENCKE3 cards.
R_1		Semimajor axis (m)
R_2		Eccentricity (deg)
R_3		Inclination (deg)

Primary Identifier: INTEG/OUT

Secondary Identifier: ENCKE2

Format: 10X, A6, I4, 3E20.13

Purpose: Specify remaining elements of reference orbit.

Data Field	Default Value	Description
R_1		Ascending node (deg).
R_2		Argument of perigee (deg).
R_3		Mean anomaly (deg).

Primary Identifier: INTEG/OUT

Secondary Identifier: ENCKE3

Format: 10X, A6, I4, 3E20.13

Purpose: Specify mean rates for reference orbit.

Data Field	Default Value	Description
R_1		Mean rate with regard to true anomaly.
R_2		Mean perigee rate with regard to true anomaly.
R_3		Mean motion (rad/sec).

Primary Identifier: INTEG/OUT

Secondary Identifier: ENCKE4

Format: 10X, A6, I4, 3E20.13

Purpose: Specify initial position displacement relative to reference orbit.

Data Field	Default Value	Description
I_1	0	
R_1		Initial x displacement (m).
R_2		Initial y displacement (m).
R_3		Initial z displacement (m).

Primary Identifier: INTEG/OUT

Secondary Identifier: ENCKE5

Format: 10X, A6, I4, 3E20.13

Purpose: Specify initial velocity displacement from reference orbit.

Data Field	Default Value	Description
R_1		Initial $\dot{x}$ displacement (m/sec).
R_2		Initial $\dot{y}$ displacement (m/sec).
R_3		Initial $\dot{z}$ displacement (m/sec).

Primary Identifier: INTEG/OUT

Secondary Identifier: ERROR

Format: 10X, A6, I4, 3E20.13

Purpose: Deactivate selected fatal errors.

Data Field	Default Value	Description
I_1		Number of error to be deactivated.
R_1	1	Error control flag If = 0, abort upon error. If = 1, stop upon error. If = −1, attempt to continue upon error (unreliable)

Primary Identifier: INTEG/OUT

Secondary Identifier: FXSTEP

Format: 10X, A6, I4, 3E20.13

Purpose: For MODE 2 through MODE 5, set integration order and step size of the fixed-step fixed-order integrator.

Data Field	Default Value	Description
I_1		Order of integration (not to exceed 16).
R_1		Step size for fixed-step integrator in seconds.
R_2	7.0E-15	Desired convergence limit for starting fixed-step integrators (changed only if non-zero).
R_3	1.0E-13	Acceptable convergence limit for starting fixed-step integrators (changed only if non-zero).

Note: If stepsize and order are 0, then nominal values will be calculated based on the initial semi-major axis.

Primary Identifier: INTEG/OUT

Secondary Identifier: IPARTE

Format: 10X, A6, I4, 3E20.13

Purpose: An option to suppress evaluation of perturbing accelerations whenever accelerations are required at the same time as the previous evaluation.

Data Field	Default Value	Description
I_1	1	Partial evaluation switch: If = 0, full evaluation. If = 1, partial evaluation.

Primary Identifier: INTEG/OUT

Secondary Identifier: LOCSIG

Format: 10X, A6, I4, 3E20.13

Purpose: Activate computation and printing of σ's for local parameters when the arc structure requires multi-arcing along with estimation of global and local parameters.

Data Field	Default Value	Description
I_1	0	Computation and printing switch: If = 0, do not compute or print. If = 1, compute and print.

Note: This option should be used with caution. Use with large numbers of arcs or large numbers of parameters will result in a great deal of disk I/O.

Primary Identifier: INTEG/OUT

Secondary Identifier: LSTPAS

Format: 10X, A6, I4, 3E20.13

Purpose: An option to suppress printing of measurement residuals and satellite state.

Data Field	Default Value	Description
I_1	0	Print control: If = 0, print information on all iterations. If = 1, print information only on the last iteration. If = 2, do not print the information on any iteration.

Primary Identifier: INTEG/OUT

Secondary Identifier: NPRINT

Format: 10X, A6, I4, 3E20.13

Purpose: A printing control parameter.

Data Field	Default Value	Description
I_1	50	Frequency of printing observations (MODE 3 and 4) or of printing state (MODE 2).

Primary Identifier: INTEG/OUT

Secondary Identifier: NPTAFT

Format: 10X, A6, I4, 3E20.13

Purpose: To set control of integration to final time in MODES 3 or 4 (has no effect if final time occurs before end of observation or trajectory file).

Data Field	Default Value	Description
I_1	0	Integration control parameter: If = 0, stop integration at last observation before TF. If = 1, integrate to TF even if last observation occurs before TF. If = 2, same as 1 but only on last iteration.

Note: If not already set to 1 or 2, NPTAFT is set to 1 automatically if multiple arcs are requested or if any UTCWRT option is activated.

Primary Identifier: INTEG/OUT

Secondary Identifier: PKPPRN

Format: 10X, A6, I4, 3E20.13

Purpose: An option to suppress printing of pass-dependent parametry solutions.

Data Field	Default Value	Description
I_1	2	Print control: If = 0, print information on all iterations. If = 1, print information only on the last iteration. If = 2, do not print the information on any iteration.

Primary Identifier: INTEG/OUT

Secondary Identifier: TF

Format: 10X, A6, I4, 3E20.13

Purpose: Set final integration time or arc length in seconds. Either TF or TFDAYS must be supplied.

Data Field	Default Value	Description
I_1	0	Flag denoting manner of setting final integration time: If = 0, R_1 is the arc length in seconds (may be negative in MODE 2). If = 1, R_1, R_2 and R_3 are the year, month and day of the final integration time. If = 2, R_1, R_2 and R_3 are the hour, minute and second of the final integration time. If = 3, R_1 and R_2 are the whole and fractional parts, respectively, of the Julian date (UTC) of the final integration time.
R_1, R_2, R_3	3*0.0	As defined above.

Note: In MODE 3 or 4, integration is carried to TF only if I_1 on the NPTAFT card is non-zero. Otherwise, integration terminates at the last observation or trajectory point before TF.

Primary Identifier: INTEG/OUT

Secondary Identifier: TFDAYS

Format: 10X, A6, I4, 3E20.13

Purpose: Set final integration time in days. Either TFDAYS or TF must be supplied.

Data Field	Default Value	Description
R_1	0.0	Final integration time in days.

Primary Identifier: INTEG/OUT

Secondary Identifier: TSTART

Format: 10X, A6, I4, 3E20.13

Purpose: Control starting time of output points in MODE 2 when MEASX = 0 or 1. Integration always starts at T = 0.0, but the output points start at T = TSTART. In MODES 3 and 4, data is accepted only after TSTART seconds past epoch.

Data Field	Default Value	Description
R_1	0.0	Time at which the first output points of prediction or trajectory write is required, or at which the first input observation will be accepted (in seconds).

PRIMARY IDENTIFIER: FILES

The inputs associated with the primary identifier FILES are used to specify which files are to be created during processing, although some files are activated in other sections. Various file control options are activated here also. The secondary identifiers, summarized below, are described in detail on the following pages.

DUZWRT – Activate square-root information matrix write to file DUZ.

GEOID – Adjust record size of direct access geoid file.

GTRACK – Activate ground track file write to file GRNDTK.

OBSDUP – Activate duplication of existing observation times in MODE 5.

OBSPOS – Control sector position and rewinding of observation file.

REGWRT – Activate measurement partial file write to file REGRES.

REPORT – Specify type of report to write to file REPORT in MODE 4.

RESWRT – Activate residual file write to file RESID.

SAMPLE – Activate sampling of data from observation file.

UTCWRT – Activate trajectory, ground track, or variational file write.

Primary Identifier: FILES

Secondary Identifier: DUZWRT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Write Givens accumulated square root information matrix for each arc to DUZ.

Data Field	Default Value	Description
I_1	0	DUZ file writing control: If = 0, do not write information matrix. If = 1, write information matrix to DUZ. If = 2, write information matrix to DUZ and covariance matrix to COVMAT.

Note: See UTOPIA FILES section for format of DUZ and COVMAT.

Primary Identifier: FILES

Secondary Identifier: GEOID

Format: 10X, A6, 2I2, 3E20.13

Purpose: Adjust record size of direct access geoid file.

Data Field	Default Value	Description
I_1	704	Record size of direct access geoid file in words.

Primary Identifier: FILES

Secondary Identifier: GTRACK

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set flag for writing ground track file GRNDTK.

Data Field	Default Value	Description
I_1	0	Ground track file switch: If = 0, do not write ground track file. If = 1, ground track file is written. If = 2, sea surface height file is written at time of altimeter observations. If = 3, radial orbit difference file is written.
R_1	6378137.	Equatorial radius in meters of the reference ellipsoid used in computing sub-satellite point (changed only if non-zero).
R_2	298.257	Reciprocal of flattening (1/f) of reference ellipsoid (changed only if non-zero).

Notes:

(1) In MODES 3, 4 and 5, ground track points are output only at the times of observations. In MODE 2, ground track points are output at the interval specified on the DTNEW card.

(2) See UTOPIA FILES section for the format of GRNDTK.

Primary Identifier: FILES

Secondary Identifier: OBSDUP

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify whether times on an existing observation file are to be duplicated when simulating observation in MODE 5.

Data Field	Default Value	Description
I_1	0	Observation duplication flag. If = 0, generate observations according to DTPASS (or DTALT) and DTMAX. If = 1, generate observations at the same times as observations on the file STATE (in UTOPIA binary format).

Notes:

(1) Individual stations or observation types can be ignored by deactivating those stations or observations types.

(2) No observation will be duplicated if the minimum elevation criteria (ELMIN) is not satisfied for that station.

Primary Identifier: FILES

Secondary Identifier: OBSPOS

Format: 10X, A6, 2I2, 3E20.13

Purpose: Controls positioning and rewinding of the observation file (OBSDAT) for iteration or multi-arc runs in MODE 4. This option can save time for multi-arc runs and for single-arc runs which iterate over intervals near the end of a large observation file.

Data Field	Default Value	Description
I_1	1	Positioning switch: If = 0, no automatic positioning is done but the observation file is rewound upon iteration. If = 1, automatic positioning and rewinding is done.

Primary Identifier: FILES

Secondary Identifier: REGWRT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Write measurement partial (regress) file to REGRES.

Data Field	Default Value	Description
I_1	0	Regress file writing control: If = 0, do not write file. If = 1, write file.

Note: See UTOPIA FILES section for format of REGRES.

Primary Identifier: FILES

Secondary Identifier: REPORT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Specify type of report to be written to REPORT for MODE 4 runs.

Data Field	Default Value	Description
I_1	1	Batch update and orbit overlap report writing control: If = 0, do not write new estimate or orbit overlaps. If = 1, write updated values for all estimated parameters in UTOPIA input format as well as orbit overlaps on the last iteration of each arc. If = 2, same as I_1 = 1, but write new estimates on all iterations.
I_2	0	Station summary write control: If = 0, do not write station summary to REPORT. If = 1, write station summary to REPORT on last iteration of each arc.

Primary Identifier: FILES

Secondary Identifier: RESWRT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate writing edited observations or residuals to RESID.

Data Field	Default Value	Description
I_1	0	File writing control: If = 0, no new observation file or residual file is created. If = 1, create a new flagged observation file (5-word format). If = 2, create a flagged residual file (7-word format). If = 3, create a flagged residual file with orbit element partials (13-word format). If = 4, create a flagged residual file with station coordinate and earth rotation partials (13-word format). If = 5, create a flagged residual file for laser range only with orbit element, station coordinate and Earth rotation partials (19-word format). If = 6, create a flagged residual file for range-rate only with Guier plane partials (19-word format). If = 7, same as 5 and 6, but laser range will be written to RESID and range-rate will be written to RESID2.

Notes:

(1) See UTOPIA FILES section for format of RESID.

(2) RESID is a binary (unformatted) file for $I_1 > 1$.

(3) Crossover residuals are written to CXRES.

(4) Altimeter residuals are written to ALTRES only if $I_1 > 0$.

Primary Identifier: FILES

Secondary Identifier: SAMPLE

Format: 10X, A6, 2I2, 3E20.13

Purpose: Activate data sampling.

Data Field	Default Value	Description
I_1	1	Data sampling increment.

Primary Identifier: FILES

Secondary Identifier: UTCWRT

Format: 10X, A6, 2I2, 3E20.13

Purpose: Set UTC output option and interval (not available in MODE 5).

Data Field	Default Value	Description
I_1	0	UTC output control flag: If = 0, all options deactivated. If = 1, print EPOCH1, EPOCH2, POS and VEL cards on REPORT every R_1 seconds. If = 2, write binary trajectory file on STATE with points every R_1 seconds. If = 3, write variational file on VARY with points every R_1 seconds. If = 4, write a ground track file on GRNDTK with points every R_1 seconds. (Set reference ellipsoid parameters using GTRACK input.) If = 5, write a card image trajectory file on REPORT with points every R_1 seconds.
R_1		DTUTC – output interval in UTC seconds

Notes:

(1) Option 3 is only available in MODE 4.

(2) The trajectories written by options 2 and 5 are available in several different coordinate systems. See SYSTEM card in STA/OBS.

(3) More than one option can be activated, but only the last value of DTUTC will be used.

PRIMARY IDENTIFIER: SOLVEPARAM

The inputs associated with the primary identifier SOLVEPARAM specify which additional quantities are to be estimated when executing either estimation mode. However, the estimation of some dynamical parameters is activated in FORCES. The secondary identifiers, summarized below, are described in detail on the following pages.

ABIAS − Activate altimeter bias or time bias estimation.

ALPHA − Activate the estimation of the refraction parameters.

ARP − Activate estimation of arp.

BIAS − Activate observation bias or time bias estimation.

BURN − Activate impulse burn estimation.

DENCOR − Activate estimation of density correction parameters.

DRAG − Activate the estimation of atmospheric drag parameters.

DRAGL − Activate the estimation of empirical drag coefficients.

DUTEST − Activate the estimation of $\delta(\mathrm{UT1}-\mathrm{TAI})$ (deviation from tabulated $\mathrm{UT1}-\mathrm{TAI}$).

DXPEST − Activate the estimation of δx_p (deviation from tabulated x_p).

DYPEST − Activate the estimation of δy_p (deviation from tabulated y_p).

ERADP − Activate the estimation of Earth radiation parameters.

GCNEST − Activate the estimation of X-Y-Z components of geocenter location.

GCNSIG − Specify a priori sigmas for geocenter location.

GEOEST − Activate the estimation of a block of geopotential coefficients.

GLOBAL − Control global parameter estimation.

GMEST − Activate the estimation of GM.

H13C − Activate estimation of significant wave height (H1/3) correction.

HFPEST − Activate the estimation of high-frequency EOPs (diurnal and semidiurnal EOPs).

Jn−DOT − Activate estimation of zonal rates.

MXDEST − Specify maximum degree geopotential coefficient to estimate for this order.

PANELS − Activate the estimation of solar panel parameters.

RADPR − Activate the estimation of radiation pressure parameters.

RELPRT − Activate the estimation of the relativistic parameters.

RTNPRT − Activate the estimation of radial, transverse and normal accelerations.

SSTEST − Activate estimation of sea surface topography parameters.

STA − Activate the estimation of tracking station coordinates.

STAXYZ − Specify whether estimating cartesian or geodetic station coordinates.

W0 − Activate estimation of W0, the value of the equipotential corresponding to the geoid.

XPSIG − Specify a priori sigmas for x_p parameters.

YBIAS − Activate estimation of y-bias acceleration.

YPSIG − Specify a priori sigmas for y_p parameters.

Primary Identifier: SOLVEPARAM

Secondary Identifier: ABIAS

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate altimeter bias or time bias estimation.

Data Field	Default Value	Description
I_2	0	Bias estimation flag. If = 0, do not estimate. If = 1, estimate.
I_3	0	Time bias estimation flag. If = 0, do not estimate time bias. If = 1, estimate time bias.
R_1	1.0E20	A priori σ for bias (m).
R_2	1.0E20	A priori σ for time bias (milliseconds).

Note: The initial values are given on the ABIAS card in STA/OBS.

Primary Identifier: SOLVEPARAM

Secondary Identifier: ALPHA

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of refraction scale parameters.

Data Field	Default Value	Description
I_1	0	Tracking station identification number.
I_2	0	Troposphere scale factor estimation flag. If = 0, do not estimate. If = 1, estimate as global parameter. If = 2, estimate as pass parameter.
I_3	0	Ionosphere scale factor estimation flag If = 0, do not estimate. If = 1, estimate as global parameter. If = 2, estimate as pass parameter.
R_1	1.0E20	A priori σ for troposphere scale factor.
R_2	1.0E20	A priori σ for ionosphere scale factor.

Note: If the station ID is 0, estimation of the scale factor (s) for all stations will be activated (or deactivated).

Primary Identifier: SOLVEPARAM

Secondary Identifier: ARP

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of arp.

Data Field	Default Value	Description
I_2	0	Estimation switch: If = 0, do not estimate. If = 1, estimate.
R_1	1.0E20	A priori sigma

Primary Identifier: SOLVEPARAM

Secondary Identifier: BIAS

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: An option to estimate the bias associated with tracking station observations.

Data Field	Default Value	Description
I_1		Tracking station ID.
I_2	0	Bias estimation switch: If = 0, do not estimate. If = 1, estimate as global parameter. If = 2, estimate as pass parameter.
I_3	0	Time bias estimation switch: If = 0, do not estimate. If = 1, estimate as global parameter. If = 2, estimate as pass parameter.
I_4	0	Bias drift estimation switch: If = 0, do not estimate. If = 1, estimate as global parameter. If = 2, estimate as pass parameter.
R_1	1.0E20	A priori σ for bias (same units as bias).
R_2	1.0E20	A priori σ for time bias (milliseconds).
R_3	1.0E20	A priori σ for bias drift (same units as bias drift).

Notes:

(1) Initial values are given by the BIAS card in STA/OBS.

(2) If the station ID is 0, estimation of the observation bias for all stations will be activated (or deactivated).

Primary Identifier: SOLVEPARAM

Secondary Identifier: BURN

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of burn accelerations in the impulse burn acceleration model.

Data Field	Default Value	Description
I_2	0	Estimation switch If = 0, do not estimate. If = 1, estimate.
R_1	1.0E20	A priori σ for burn acceleration.

Primary Identifier: SOLVEPARAM

Secondary Identifier: DENCOR

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: An option to estimate once/rev density correction parameters.

Data Field	Default Value	Description
I_2	0	Density correction estimation switch: If = 0, do not estimate once/rev density correction. If = 1, estimate once/rev density.
R_1	1.0E20	A priori σ for density correction.

Primary Identifier: SOLVEPARAM

Secondary Identifier: DRAG

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of the drag parameters C_d and $\dot{C}_d$.

Data Field	Default Value	Description
I_2	0	Number of drag parameters to estimate: If = 0, do not estimate either C_d or $\dot{C}_d$. If = 1, estimate C_d. If = 2, estimate C_d and $\dot{C}_d$.
R_1	1.0E20	A priori σ for C_d.
R_2	1.0E20	A priori σ for $\dot{C}_d$.

Primary Identifier: SOLVEPARAM

Secondary Identifier: DRAGL

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of coefficients in empirical drag model.

Data Field	Default Value	Description
I_2	0	Number of non-periodic drag terms to estimate. If = 0, do not estimate C_t or $\dot{C}_t$. If = 1, estimate only C_t. If = 2, estimate C_t and $\dot{C}_t$.
I_3	0	Number of periodic drag terms to estimate.
R_1	1.0E20	A priori σ for C_t.
R_2	1.0E20	A priori σ for $\dot{C}_t$.
R_3	1.0E20	A priori σ for periodic terms.

Primary Identifier: SOLVEPARAM

Secondary Identifier: DUTEST

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of $\delta(\mathrm{UT1}-\mathrm{TAI})$ (deviation from tabulated $\mathrm{UT1}-\mathrm{TAI}$).

Data Field	Default Value	Description
I_2	0	Estimation flag If = 0, do not estimate. If = 1, estimate.
R_1	0.0	Initial value for $\delta(\mathrm{UT1}-\mathrm{TAI})$ in seconds.
R_2	1.0E20	A priori σ for first subarc.
R_3	1.0E20	A priori σ for remaining subarcs.

Primary Identifier: SOLVEPARAM

Secondary Identifier: DXPEST

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of δx_p (deviation from tabulated x_p).

Data Field	Default Value	Description
I_2	0	Estimation flag If = 0, do not estimate. If = 1, estimate.
R_1	0.0	Initial value for δx_p (arcsec).
R_2	1.0E20	A priori σ for δx_p.

Note: If δx_p is being estimated, δy_p must also be estimated.

Primary Identifier: SOLVEPARAM

Secondary Identifier: DYPEST

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of δy_p (deviation from tabulated y_p).

Data Field	Default Value	Description
I_2	0	Estimation flag If = 0, do not estimate. If = 1, estimate.
R_1	0.0	Initial value for δy_p (arcsec).
R_2	1.0E20	A priori σ for δy_p.

Note: If δy_p is being estimated, δx_p must also be estimated.

Primary Identifier: SOLVEPARAM

Secondary Identifier: ERADP

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of the satellite reflectivity parameters η_e and $\dot{\eta}_e$ for Earth radiation pressure.

Data Field	Default Value	Description
I_2	0	Number of reflectivity parameters to estimate: If = 0, do not estimate η_e or $\dot{\eta}_e$. If = 1, estimate η_e only. If = 2, estimate both η_e and $\dot{\eta}_e$
R_1	1.0E20	A priori σ for η_e.
R_2	1.0E20	A priori σ for $\dot{\eta}_e$.

Note: To estimate individual albedo or emissivity coefficients, see the ERADP1 card in FORCES.

Primary Identifier: SOLVEPARAM

Secondary Identifier: GCNEST

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of X-Y-Z components of geocenter location.

Data Field	Default Value	Description
I_2	0	Estimation flag If = 0, do not estimate. If = 1, estimate.
R_1	0.0	Initial value for G_x.
R_2	0.0	Initial value for G_y.
R_3	0.0	Initial value for G_z.

Note: A priori σ's are set in GCNSIG card.

Primary Identifier: SOLVEPARAM

Secondary Identifier: GCNSIG

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Specify a priori sigmas for geocenter location.

Data Field	Default Value	Description
R_1	1.0E20	A priori sigma for G_x (m).
R_2	1.0E20	A priori sigma for G_y (m).
R_3	1.0E20	A priori sigma for G_z (m).

Primary Identifier: SOLVEPARAM

Secondary Identifier: GEOEST

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of all geopotential coefficients below a given degree and order.

Data Field	Default Value	Description
I_2	0	Estimate all zonals with degree $\leq I_2$.
I_3, I_4	0, 0	Estimate all tesserals and sectorials with degree $\leq I_3$ and order $\leq I_4$.

Notes:

(1) Only coefficients explicitly appearing in the geopotential file or the input deck can be estimated this way.

(2) Only cards with "NOEST" appearing in the first six columns will be excluded from the estimation set.

(3) Once estimation of a coefficient is activated, it cannot be deactivated.

(4) See GEOSUB card in FORCES about specifying the a priori σ for estimated coefficients.

(5) Estimation of $C_{1,0}$ $C_{1,1}$, $S_{1,1}$, $C_{2,1}$, $S_{2,1}$ cannot be activated with this input (see GEOSUB in FORCES).

Primary Identifier: SOLVEPARAM

Secondary Identifier: GLOBAL

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Control estimation of global parameters. Each arc will be a separate solution for all estimated parameters if global parameters are deactivated.

Data Field	Default Value	Description
I_2	1	Global parameter estimation flag. If = 0, deactivate global parameters. If = 1, activate global parameters.

Primary Identifier: SOLVEPARAM

Secondary Identifier: GMEST

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of the gravitational constant GM for the Earth.

Data Field	Default Value	Description
I_2	0	Estimation switch: If = 0, do not estimate GM. If = 1, estimate GM.
R_1		A priori σ for GM in km^3/s^2.

Primary Identifier: SOLVEPARAM

Secondary Identifier: H13C

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of significant wave height (H1/3) correction factor.

Data Field	Default Value	Description
I_2	0	Estimation switch for H1/3 correction factor.
R_1	1.0E20	A priori σ for H1/3 correction factor.

Note: Initial value of H1/3 correction factor given on ABIAS card in STA/OBS.

Primary Identifier: SOLVEPARAM

Secondary Identifier: HFPEST

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of high-frequency EOPs (diurnal and semidiurnal EOPs).

Data Field	Default Value	Description
I_2	0	Estimation flag If = 0, do not estimate any. If = 1, estimate only diurnal EOPs. If = 2, estimate diurnal and semidiurnal EOPs.
I_3	0	Flag for singular diurnal EOPs If = 0, do not estimate retrograde diurnal EOPs. If = 1, estimate retrograde diurnal EOPs.

Primary Identifier: SOLVEPARAM

Secondary Identifier: Jn − DOT

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of the linear changes in the zonal geopotential coefficients.

Data Field	Default Value	Description
<n>		Identifies degree of zonal (≤5)
I_2	0	Estimation switch: If = 0, do not estimate Jn − DOT. If = 1, estimate Jn − DOT.
R_1	0.0	A priori σ for Jn − DOT.

Primary Identifier: SOLVEPARAM

Secondary Identifier: MXDEST

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Specify maximum degree geopotential coefficient to estimate for this order.

Data Field	Default Value	Description
I_2		Geopotential order
I_4		Maximum degree to estimate for specified order.

Note: Minimum degree will not be less than 2.

Primary Identifier: SOLVEPARAM

Secondary Identifier: PANELS

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of solar panel parameters.

Data Field	Default Value	Description
I_2	0	Solar panel reflectivity (η_p) switch: If = 0, do not estimate the reflectivity. If = 1, estimate the reflectivity.
I_3	0	Solar panel drag coefficient (c_{dp}) switch: If = 0, do not estimate the drag coefficient. If = 1, estimate the drag coefficient.
R_1	1.0E20	A priori σ for η_p.
R_2	1.0E20	A priori σ for c_{dp}.

Primary Identifier: SOLVEPARAM

Secondary Identifier: RADPR

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of the solar radiation reflectivity parameters η, $\dot{\eta}$, and twice-per-rev area variation amplitude ΔA.

Data Field	Default Value	Description
I_2	0	Number of reflectivity parameters to estimate: If = 0, do not estimate η or $\dot{\eta}$. If = 1, estimate η only. If = 2, estimate both η and $\dot{\eta}$.
R_1	1.0E20	A priori σ for η.
R_2	1.0E20	A priori σ for $\dot{\eta}$.

Primary Identifier: SOLVEPARAM

Secondary Identifier: RELPRT

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of relativistic parameters β and γ.

Data Field	Default Value	Description
I_2	0	β estimation flag. If = 0, do not estimate β. If = 1, estimate β.
I_3	0	γ estimation flag. If = 0, do not estimate γ. If = 1, estimate γ.
R_1	1.0E20	A priori σ for β.
R_2	1.0E20	A priori σ for γ.

Primary Identifier: SOLVEPARAM

Secondary Identifier: RTNPRT

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: An option to estimate the radial, transverse or normal accelerations.

Data Field	Default Value	Description
I_2	0	Radial acceleration switch: If = 0, not estimate periodic radial acceleration. If = 1, estimate periodic radial acceleration.
I_3	0	Transverse acceleration switch: If = 0, not estimate periodic transverse acceleration. If = 1, estimate periodic transverse acceleration.
I_4	0	Normal acceleration switch: If = 0, not estimate periodic normal acceleration. If = 1, estimate periodic normal acceleration.
R_1	1.0E20	A priori σ for radial acceleration.
R_2	1.0E20	A priori σ for transverse acceleration.
R_3	1.0E20	A priori σ for normal acceleration.

Primary Identifier: SOLVEPARAM

Secondary Identifier: SSTEST

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate estimation of all sea surface topography coefficients below a given degree and order.

Data Field	Default Value	Description
I_2	0	Estimate all zonals with degree $\leq I_2$
I_3, I_4	0, 0	Estimate all tesserals and sectorials with degree $\leq I_3$ and order $\leq I_4$

Primary Identifier: SOLVEPARAM

Secondary Identifier: STA

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of station coordinates. Use STAXYZ card to change estimation from geodetic to cartesian station coordinates.

Data Field	Default Value	Description
I_1		Tracking station ID.
I_2	0	Estimation switch for height above reference ellipsoid (or X coordinate): If = 0, do not estimate. If = 1, estimate as global parameter. If = 2, estimate as pass parameter.
I_3	0	Estimation switch for longitude (or Y coordinate): If = 0, do not estimate. If = 1, estimate as global parameter. If = 2, estimate as pass parameter.
I_4	0	Estimation switch for geodetic latitude (or Z coordinate): If = 0, do not estimate. If = 1, estimate as global parameter. If = 2, estimate as pass parameter.
R_1	1.0E20	A priori σ for height (or X) (m) .
R_2	1.0E20	A priori σ for longitude (or Y) (m) .
R_3	1.0E20	A priori σ for latitude (or Z) (m) .

Note: If the station ID is 0, estimation of coordinates for all stations is activated (or deactivated).

Primary Identifier: SOLVEPARAM

Secondary Identifier: STAXYZ

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Change station coordinate estimation from geodetic to cartesian coordinates.

Data Field	Default Value	Description
I_1	0	Station estimation system identifier. If = 0, estimate geodetic coordinates (height, latitude, longitude). If = 1, estimate cartesian coordinates (X,Y,Z).

Primary Identifier: SOLVEPARAM

Secondary Identifier: W0

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation for the value of the equipotential surface corresponding to the geoid.

Data Field	Default Value	Description
I_2	0	Estimation flag. If = 0, do not estimate. If = 1, estimate.
R_1	1.0E20	A priori σ for W_0 estimation.

Note: The initial value is given on the GEOIDC card in STA/OBS.

Primary Identifier: SOLVEPARAM

Secondary Identifier: YBIAS

Format: 10X, A6, I4, 3I2, 3E15.8

Purpose: Activate the estimation of the y-bias acceleration.

Data Field	Default Value	Description
I_2	0	Estimation flag. If = 0, do not estimate. If = 1, estimate constant y-bias acceleration. If = 2, estimate y-bias acceleration and its slope.
R_1	1.0E20	A priori σ for y-bias estimation.
R_2	1.0E20	A priori σ for y-bias slope estimation.

Note: The initial values are given on the YBIAS card in FORCES.

PRIMARY IDENTIFIER: PLOT

The inputs associated with the PLOT primary identifier specify which quantities will be plotted and what type of plots will be generated. The secondary identifiers, summarized below, are described in detail on the following pages. A maximum of 15000 observation residuals per pass and 5000 orbit differences per arc can be plotted. If the number of points to be plotted exceeds these limits, the points will be sampled.

DIMXY – Specify scales and dimensions for plots.

GTRACK – Specify line type for residual plotting.

PLITER – Activate plotting of residuals on all iterations.

PLOTS – Activate plotting and specify type.

SAMPLE – Generate only a sampling of the individual pass residual plots.

The following apply only to MODE 2 or to MODE 4/MEASX runs:

ORBPLT – Activate plots of orbit elements or their differences.

ORB1 – Suppress individual orbit element plots.

ORB2 – Suppress individual orbit element plots.

RTNPLT – Suppress plots of radial, transverse or normal orbit differences.

Primary Identifier: PLOT

Secondary Identifier: DIMXY

Format: 10X, A6, 4X, 3I2, 3E15.8

Purpose: To set the scale units and plot dimensions.

Data Field	Default Value	Description
I_1	0	Units for time axis of plots: If = 0, time is in minutes. If = 1, time is in hours. If = 2, time is in days. If = 3, time is in seconds.
I_2	49	Number of rows for line printer plots (changed only if ≥ 10).
I_3	111	Number of columns for line printer plots (changed only if ≥ 10).
R_3	1.0	Scale factor for RTN orbit differences for MEASX runs. Used only if 100.0 (for cm) or 1000.0 (for mm).

Primary Identifier: PLOT

Secondary Identifier: GTRACK

Format: 10X, A6, 4X, 3I2, 3E15.8

Purpose: Activate plotting of ground-track distribution for each station.

Data Field	Default Value	Description
I_1	0	Ground-track plot control: If = 0, do not plot ground-tracks for each station. If = 1, plot ground-tracks for each station. If = 2, plot ground-track distribution but suppress residual plots (useful for MODE 5).

Primary Identifier: PLOT

Secondary Identifier: ORBPLT

Format: 10X, A6, 4X, 3I2, 3E15.8

Purpose: To activate plotting of orbit elements in MODE 2 prediction runs, or of orbit element differences in MODE 2 trajectory comparison or in MODE 4 trajectory fit runs.

Related Inputs: MEASX, SYSTEM, PLOTS

Data Field	Default Value	Description
I_1	0	Orbit element plotting switch: If = 0, do not plot orbit elements or their differences. If = 1, plot orbit elements or their differences.

Notes:

(1) Individual orbit elements can be suppressed using the ORB1 or ORB2 cards as described on the following pages.

(2) The SYSTEM card can be used to specify the coordinate system for orbit element plots.

Primary Identifier: PLOT

Secondary Identifier: ORB1

Format: 10X, A6, 4X, 3I2, 3E15.8

Purpose: Used with the ORBPLT card to activate or suppress individual orbit element plots for semi-major axis (a), eccentricity (e), or inclination (i).

Data Field	Default Value	Description
I_1	1	Switch for plotting a or δa: If = 0, do not plot. If = 1, plot.
I_2	1	Switch for plotting e or δe: If = 0, do not plot. If = 1, plot.
I_3	1	Switch for plotting i or δi: If = 0, do not plot. If = 1, plot.

Primary Identifier: PLOT

Secondary Identifier: ORB2

Format: 10X, A6, 4X, 3I2, 3E15.8

Purpose: Used with the ORBPLT card to activate or suppress individual orbit element plots for argument of periapse (ω), longitude of the node (Ω), or argument of latitude (u). The argument of latitude is defined as the argument of periapse plus the true anomaly.

Data Field	Default Value	Description
I_1	1	Switch for plotting ω or δω: If = 0, do not plot. If = 1, plot.
I_2	1	Switch for plotting Ω or δΩ: If = 0, do not plot. If = 1, plot.
I_3	1	Switch for plotting u or δu: If = 0, do not plot. If = 1, plot.

Primary Identifier: PLOT

Secondary Identifier: PLITER

Format: 10X, A6, 4X, 3I2, 3E15.8

Purpose: To activate plotting on every iteration in MODE 4.

Data Field	Default Value	Description
I_1	0	Switch for plotting: If = 0, plot only the last iteration. If = 1, plot every iteration.

Primary Identifier: PLOT

Secondary Identifier: PLOTS

Format: 10X, A6, 4X, 3I2, 3E15.8

Purpose: Activate line printer plotting.

Data Field	Default Value	Description
I_1	1	Plot type identifier: If = 0, no plots. If = 1, line printer plots.

Primary Identifier: PLOT

Secondary Identifier: RTNPLT

Format: 10X, A6, 4X, 3I2, 3E15.8

Purpose: To deactivate plotting of radial, transverse, or normal orbit differences (RTN) in MODE 2 trajectory comparison or in MODE 4 trajectory fit runs.

Data Field	Default Value	Description
I_1	1	Plot switch for radial orbit differences: If = 0, not plot radial orbit differences. If = 1, plot radial orbit differences. If = 2, plot x-component differences instead.
I_2	1	Plot switch for transverse orbit differences: If = 0, do not plot transverse orbit differences. If = 1, plot transverse orbit differences. If = 2, plot y-component differences instead.
I_3	1	Plot switch for normal orbit differences: If = 0, do not plot normal orbit differences. If = 1, plot normal orbit differences. If = 2, plot z-component differences instead.

Primary Identifier: PLOT

Secondary Identifier: SAMPLE

Format: 10X, A6, 4X, 3I2, 3E15.8

Purpose: Specify sampling control for residual plots when plotting individual pass residuals. This input has no effect unless DTNEW in INTEG/OUT is small.

Data Field	Default Value	Description
I_1	1	Sampling control (i.e., plot every I_1th station pass).

UTOPIA FILES

UNIT	FILE NAME	TYPE	DESCRIPTION
1.	REGRES	unformatted	measurement partial file
2.	VARY	unformatted	variational file
3.	DUZ	unformatted	D-U-Z file
4.	COVMAT	unformatted	covariance matrix
5.	stdin	formatted	input directives
6.	stdout	formatted	output listing
7.	GRNDTK	formatted	ground track file
8.	GEO	formatted	geopotential file
9.	EOPDAT	formatted	earth orientation file
10.	STATE	formatted/unformatted	trajectory file
11.	OBSDAT	formatted/unformatted	observation file
13.	HPDATA	formatted	Harris-Priester density tables
14.	RESTRT	formatted/unformatted	integration/accumulation restart file
15.	SST	formatted	sea surface topography file
16.	REPORT	formatted	statistics and update report file
17.	RESID	formatted/unformatted	residual file
18.	NETWRK	formatted	ocean loading coefficients
19.	RESID2	unformatted	secondary residual file
20.	REJECT	formatted	rejected observations
21.	FLXDAT	direct access	solar flux and geomagnetic indices
22.	EPHDAT	direct access	JPL DE200 planetary ephemeris
23.	UPDPDP	direct access	pass dependent parameter updates
24.	GEOID	direct access	numerical geoid heights
25.	IONMAP	direct access	numerical ionosphere map
26.	BFMAP	direct access	numerical geomagnetic field map
27.	MANEUVER	formatted	maneuver table
31.	FT31	unformatted	crossover partials scratch file
32.	FT32	unformatted	multi-use scratch file
33.	FT33	formatted	input processing scratch file
34.	FT34	formatted	input processing scratch file
35.	FT35	unformatted	residual statistics scratch file
36.	FT36	unformatted	plotting scratch file
37.	FT37	unformatted	observation storage scratch file
38.	FT38	formatted	input processing scratch file
39.	FT39	formatted	estimation scratch file
40.	OTIDES	formatted	ocean tide file
71.	CXRES	formatted	altimeter crossover residual file
72.	ALTRES	formatted	altimeter residual file
77.	SCF	formatted	station solution file
95.	POLSOLN	formatted	subarc polar motion solution file
96.	UT1SOLN	formatted	subarc UT1 solution file
97.	GCNSOLN	formatted	geocenter solution file
98.	HFPSOLN	formatted	high frequency polar motion file

ALTIMETER RESIDUAL FILE FORMAT

Header Records format: (F16.9, F16.10, 5F10.4)

Record	Item	Contents
1	1	Arc epoch (UTC modified Julian date)
	2	Initial argument of latitude (deg)
	3	$H_{1/3}$ scale factor applied (m/m)
	4	Time bias (msec)
	5	Inverted barometer scale factor (mm/mbar)
	6	Inverted barometer mean pressure (mbar)
	7	Altimeter bias applied (m)
2	1	Format for residual records

Data Records

Record	Item	Contents
1	1	ALTRES
	2	Geodetic latitude (deg)
	3	East longitude (deg)
	4	Modified Julian date of observation (UTC)
	5	Observation standard deviation (m)
	6	Altimeter residual (m)
	7	Geoid height correction (m)
	8	Ocean tide correction (m)
	9	Sea surface topography correction (m)
	10	Inverted barometer correction (m)
	11	Atmospheric pressure (mbar)
2	Altimeter card image (108 characters)	

Notes:

1. Remove a correction from the residual by subtracting the correction.
2. A point which has its edit flag set will have a standard deviation of 999 m.

COVARIANCE FILE FORMAT

Record	Number	Type	Contents
1	1	A10	program name and version number
	4	A70	run description
	1	A10	date of job
	1	A10	time of job
2	1	I	number of global parameters (N)
3	N	A10	parameter labels
4	N	R	solutions
5	N	R	sigmas
6	N	R	scale factors
7	N	R	covariance matrix (upper
8	N-1	R	triangular by rows)
9	N-2	R	
⋮	⋮	⋮	
N+6	1	R	

COVARIANCE MATRIX FILE FORMAT (ASCII)

Record Contents	Number of quantities	Number of records*	Format
Solution information			
Job description	6	6	A80
Parameter information			
Number of parameters (n)	1	1	I10
Labels	n	n/8	8A10
Solutions	n	n/4	4E20.14
Sigmas	n	n/4	4E20.14
Scale factors†	n	n/4	4E20.14
Covariance matrix (upper triangular by rows)			
First row	n	n/4	4E20.14
Second row	n–1	(n–1)/4	4E20.14
Third row	n–2	(n–2)/4	4E20.14
⋮	⋮	⋮	⋮
Last row	1	1	E20.14

* Any fraction remaining indicates one additional record.

† Scale factor required to convert solution to proper units (e.g., if geopotential coefficients have been scaled up by 10^6, then the solutions and sigmas must be scaled down by 10^{-6} and the covariance must be scaled down by 10^{-12}).

ALTIMETER CROSSOVER RESIDUAL FILE FORMAT

Header Records format: (F16.9, F16.10, 4F10.4)

Record	Item	Contents
1	1	Arc epoch (UTC modified Julian date)
	2	Initial argument of latitude (deg)
	3	$H_{1/3}$ scale factor applied (m/m)
	4	Time bias (msec)
	5	Inverted barometer scale factor (mm/mbar)
	6	Inverted barometer mean pressure (mbar)
2	1	Format for residual records

Data Records

Record	Item	Contents
1	1	CXRES
	2	Geodetic latitude (deg)
	3	East longitude (deg)
	4	MJD of first height (UTC)
	5	MJD of second height (UTC)
	6	Observation standard deviation (m)
	7	Crossover residual (m)
	8	Inverted barometer correction (m)
	9	Ocean tide correction (m)
2	First altimeter crossover card image (108 characters)	
3	Second altimeter crossover card image (108 characters)	

Notes:

1. Remove a correction from the residual by subtracting the correction.
2. A point which has its edit flag set will have a standard deviation of 999 m.
3. A crossover residual is calculated by subtracting the height residual at the second time from the height residual at the first time.

D-U-Z FILE FORMAT

	Record	Number	Type	Contents
File header				
	1	1	A10	program name and version number
		4	A70	run description
		1	A10	date of job
		1	A10	time of job
	2	1	I	number of arcs (NARC)
		1	I	number of stations (NSTA)
	3	NSTA	A10	station names
	4	NSTA	I	station identification numbers
	5	2	R	equatorial radius and flattening of reference ellipsoid
	6	3*NSTA	R	station coordinates (h, λ, ϕ)
Arc header for arc 1				
	7	1	I	number of satellites (NS)
		1	I	obsolete parameter − formerly number of force parameters excluding state (NF); currently set to value of NP
		1	I	number of parameters excluding state (NP)
		1	I	number of rows of Z,D,U on this arc (NROW) − note that for arcs before the last arc, NROW = number of local parameters, and for the last arc NROW = N.
		1	I	arc number
		1	DP	arc epoch (UTC Julian date)
	8	1	I	id number of first satellite
		6	R	state of first satellite
	⋮			
	8+NS−1	1	I	id no. of NS*th* satellite
		6	R	state of NS*th* satellite
	8+NS	N	R	apriori values of parameters
	9+NS	N	A10	names of parameters
	10+NS	N	R	sigmas of parameters
	11+NS	N	R	scale factors of parameters N = NP+6*NS

Record	Number	Type	Contents
Data records for arc 1			
1+(11+NS)	N+2	R	z(1), d(1), u(1,1), · · · u(1,N)
2+(11+NS)	N+1	R	z(2), d(2), u(2,2), · · · u(2,N)
⋮	⋮		
NROW+(11+NS)	N−NROW+3	R	z(NROW), d(NROW), u(NROW,NROW), · · · u(NROW,N)
⋮			
Arc header for arc NARC			
Data records for arc NARC			

Note: Records 3, 4, 5 and 6 are absent if NSTA = 0, and records 8 through 8+NS−1 are absent if NS = 0. Here is the file containing the duz format notes.

DUZ FILE FORMAT NOTES

NF and NGA on DUZ Files

1. Summary

NF is an obsolete parameter slot on a DUZ file.

The NGA slot is now called NROW. It is equal to the number of rows of Z,D,U on the DUZ arc. In old single-arc DUZ files, this slot is set to various quantities.

2. Discussion

On REGRES files

NF = number of force parameters excluding state
NGA = number of measurement models

When DUZ files came along, these quantities were no longer needed. In some versions of UTOPIA, they are set to the above values, while in other versions, they are not. On new DUZs, NF is simply set to NP. NP is another parameter in the arc header and is equal to the number of parameters excluding satellite state. In general, assume NF is an obsolete parameter slot on a DUZ file.

As for NGA, it cannot be trusted to be the number of measurement models. In single-arc DUZs, the value of NGA varies with the version of UTOPIA. Sometimes it is the number of measurement models, sometimes it is set to NP. For single-arc DUZs, assume NGA is an obsolete parameter slot on a DUZ file.

However, the NGA slot is used on multi-arc DUZs. On a multi-arc DUZ, on non-final arcs, only the rows of Z,D,U for the local parameters are written to the DUZ file. On the final arc, the rows of Z,D,U for the local plus global parameters for the final arc are written to the DUZ file.

There is no problem knowing how many rows of Z,D,U there are on the final arc. The number of rows is equal to the total number of parameters on the final arc. This can be calculated from quantities on the final arc header. The quantities needed are

NS = number of satellites
NP = number of parameters excluding satellite state

From these, the total number of parameters is

N = total number of parameters = 6*NS + NP

So the number of rows of Z,D,U on the final arc is N.

But you also need to know how many rows of Z,D,U are on non-final arcs. The number of rows of Z,D,U on non-final arcs is equal to the number of local parameters for those arcs. Let

NLOCAL = number of local parameters on an arc
NROW = number of Z,D,U rows on an arc

The value of NROW has to be written onto the arc headers for the non-final arcs. It is written in the NGA slot. Thus NGA = NROW = NLOCAL for non-final arcs on a multi-arc DUZ.

That is what is written to the NGA slot for non-final arcs on multi-arc DUZs. What about the NGA slot for final arcs on multi-arc DUZs. On the multi-arc DUZs I have looked at, NGA = NROW = N for final arcs. So programs that read DUZs could use NGA to know how many rows of Z,D,U to read on the final arc of multi-arc DUZs. But they don't. Instead, programs that read DUZs calculate N for the final arc and use that value for NROW. The reason for this may be as follows. Perhaps in the early days of DUZs, there were no multi-arc DUZs. On single-arc DUZs, NROW = N. When multi-arc DUZs came along, the NGA slot was used to store the value of NROW on non-final arcs of multi-arc DUZs. As for the final arc of multi-arc DUZs, the value of NROW is N, just as on single-arc DUZs. So the programs that read DUZs were modified to do something different only for non-final arcs of multi-arc DUZs. That something different was to set NROW = NGA. For final arcs of multi-arc DUZs and for single-arc DUZs, the code could stay the same, which is NROW = N.

Note that in UTOPIA 9105, the NGA slot for all arcs for all DUZs is set to NROW.

EARTH ORIENTATION FILE FORMAT

Header Records

Record	Item	Contents
1	1	Format for next card (20 characters)
2	1	Julian Date (UTC) of first value in table
	2	Number of table values
	3	Table interval in days
3	1	Format for data records (20 characters)

Data Records

Item	Contents
1	Modified Julian Date of table value
2	x_p component of polar motion (arcseconds)
3	y_p component of polar motion (arcseconds)
4	TAI-UTC (seconds)
5	UT1*-TAI (seconds)

* UT1R (Earth rotation with short period tide variations removed) if SPDUT1 (in FORCES) activated in UTOPIA

EPHEMERIS FILE FORMAT

File header record (828 words or 6624 bytes)

Number	Type	Contents
1	DP	beginning Julian date of planetary ephemeris file (ET)
1	DP	final Julian date
1	I	record length in days
36	I	pointers*
787	I	zero fill

Data records (828 words or 6624 bytes)

Number	Type	Contents
1	DP	first Julian date for this record
1	DP	last Julian date for this record
824	R	coefficients for Chebyshev interpolation

* The pointers specify for each planet and nutation the number of coefficients (i.e., the order of interpolation), the starting location within the record, and the number of parameters interpolated (usually 3, except 2 for nutation).

GEOPOTENTIAL FILE FORMAT

Header Records

Record	Item	Contents
1	1	Format for next card (20 characters)
2	1	File description (20 characters)
	2	Value for GM for scaling geopotential (m^3/sec^2)
	3	Equatorial radius (m)
3	1	Format for data records (20 characters)

Data Records

Item	Contents
1	6 character flag − ignored except when containing the string ESTIM (see GEOSUB input description in FORCES)
2	Degree of coefficient (n)
3	Order of coefficient (m)
4	C_{nm}
5	S_{nm}
6	Sigma of C_{nm}
7	Sigma of S_{nm}
8	Normalization flag If = −1.0, coefficients are normalized Otherwise, coefficients are unnormalized

GROUND TRACK FILE FORMAT

	Record	Type	Contents
Header records:	1−13	Formatted	Job, format, and reference ellipsoid information
For each output point:		Formatted	Time past arc epoch in seconds
			Geodetic latitude of sub-satellite point in degrees
			East longitude of sub-satellite point in degrees
			Height above reference ellipsoid or radial orbit difference or altimeter residual

Format: (F15.6, F15.8, F15.8, F15.4)

OCEAN TIDE FILE FORMAT

Header Records

Record	Item	Contents
1	1	File description (80 characters)
2	1	Number of constituents
	2	Number of perturbations
	3	Maximum degree n
	4	Maximum order
3	1	Non-zero if solid Earth tides included
4	1	Earth equatorial radius (m)
	2	Density of sea water (kg/m^3)
	3	Earth's mass (kg)
5	1-n	Load Love numbers

Constituent Records format: (F8.3, A4, 2X, I2, 2X, 3F20.12)

Item	Contents
1	Doodson argument number of constituent
2	Darwin name
3	Number of perturbations for this constituent
4	Tide height (m)
5	Frequency (cycles/solar day)
6	Doodson/Warburg phase correction (deg)
7	Love number from Wahr's theory
8	Nominal Love number

Perturbation Records format: (10X, I2, 1X, A7, A4, 2I2, 2X, 4E22.14, I2)

Item	Contents
1	Estimation flag: 0 − do not estimate 1 − estimate prograde tide only 2 − estimate retrograde tide only 3 − estimate prograde tide and retrograde tide <0 − ignore this card
2	Doodson argument number of constituent
3	Darwin name
4	Degree
5	Order
6	Cosine coefficient of prograde tide (cm)
7	Sine coefficient of prograde tide (cm)
8	Cosine coefficient of retrograde tide (cm)
9	Sine coefficient of retrograde tide (cm)
10	Unnormalized if 0; normalized if −1

MEASUREMENT PARTIAL FILE FORMAT

	Record	Number	Type	Contents
File header				
	1	1	A10	program name and version number
		4	A70	run description
		1	A10	date of job
		1	A10	time of job
	2	1	I	number of arcs
		1	I	number of stations (NSTA)
	3	NSTA	A10	station names
	4	NSTA	I	station identification numbers
	5	2	R	equatorial radius and flattening of reference ellipsoid
	6	3*NSTA	R	station coordinates (h, λ, ϕ)
Arc header				
	7	1	I	number of satellites (NS)
		1	I	number of force parameters excluding state (NF)
		1	I	number of parameters excluding state (NP)
		1	I	number of measurement models (NGA)
		1	I	arc number
		1	DP	arc epoch (UTC Julian date)
	8	NS	I	satellite id number
		6*NS	R	satellite state
	8+NS	N	R	apriori values of parameters
	9+NS	N	A10	names of parameters
	10+NS	N	R	sigmas of parameters
	11+NS	N	R	scale factors of parameters N = 6*NS+NP

Record	Number	Type	Contents
Measurement partial records			
For each observation:	1	R	UTC seconds past arc epoch
	1	I	measurement type
	1	I	station identifier
	1	R	residual
	1	R	sigma
	NF+6	R	dynamical parameter partials
	NGA	I	pointers indicating position of kinematical parameter in state vector; if zero, the measurement does not depend on this measurement model and the partial is zero
	NGA	R	kinematical parameter partials

Notes:

1. If there are additional arcs, the end of an arc is indicated by a short record.
2. Records 3, 4, 5 and 6 are absent if NSTA = 0, and record 8 is absent if NS = 0.

OBSERVATION RESIDUAL FILE FORMAT (IFILE = 2−5)

	Record	Number	Type	Contents
File header				
	1	1	A10	program name and version number
		4	A70	run description
		1	A10	date of job
		1	A10	time of job
	2	1	I	number of arcs
		1	I	number of stations (NSTA)
	3	NSTA	A10	station names
	4	NSTA	I	station identification numbers
	5	2	R	equatorial radius and flattening of reference ellipsoid
	6	3*NSTA	R	station coordinates (h, λ, ϕ)
	7	3*NSTA	R	station coordinates (x, y, z)
	8	3*NSTA	R	station velocities ($\dot{x}$, $\dot{y}$, $\dot{z}$)
	9	NSTA	R	crustal plate assignment
	10	1	R	arc length in UTC seconds
		1	DP	arc epoch (Julian date)
		1	I	residual file type indicator (IFILE)
Observation residual records				
		1	DP	Julian date (UTC) of observation
		1	R	sigma (m or cm/sec)
		1	I	station identifier
		1	R	residual
		1	R	observation time derivative
		1	R	elevation angle (deg)
		6	R	orbit element partials (if IFILE = 3 or 5)
		6	R	station coordinate (x, y, z) and earth rotation (x_p, y_p, DUT) partials (if IFILE = 4 or 5)
		1	A96	observation card image

Note: For IFILE = 1, no header record is written, and the original observation cards are repeated with the edit flag set by UTOPIA. The RESID file is a formatted file in this case.

OBSERVATION RESIDUAL FILE FORMAT (IFILE = 6)

	Record	Number	Type	Contents
File header				
	1	1	A10	program name and version number
		4	A70	run description
		1	A10	date of job
		1	A10	time of job
	2	1	I	number of arcs
		1	I	number of stations (NSTA)
	3	NSTA	A10	station names
	4	NSTA	I	station identification numbers
	5	2	R	equatorial radius and flattening of reference ellipsoid
	6	3*NSTA	R	station coordinates (h, λ, ϕ)
	7	3*NSTA	R	station coordinates (x, y, z)
	8	3*NSTA	R	station velocities ($\dot{x}$, $\dot{y}$, $\dot{z}$)
	9	NSTA	R	crustal plate assignment
	10	1	R	arc length in UTC seconds
		1	DP	arc epoch (Julian date)
		1	I	residual file type indicator (IFILE)
Observation residual records				
		1	DP	Julian date (UTC) of observation
		1	R	sigma (m or cm/sec)
		1	I	station identifier
		1	R	residual
		1	R	observation time derivative
		1	R	elevation angle (deg)
		6	R	local topocentric position and velocity (at end of count interval)
		3	R	local topocentric position at beginning of count interval*
		1	R	sine of elevation angle (at end of count interval)
		1	R	sine of elevation angle at beginning of count interval*
		1	R	tropospheric refraction correction (m or cm/sec)
		1	A96	observation card image

SEA SURFACE TOPOGRAPHY FILE FORMAT

Header Records

Record	Item	Contents
1	1	Format for next card (20 characters)
2	1	File description (60 characters)
3	1	Format for data records (20 characters)

Data Records

Item	Contents
1	6 character flag − ignored except when containing the string ESTIM (see SSTSUB input description in FORCES)
2	Degree of coefficient (n)
3	Order of coefficient (m)
4	C_{nm}
5	S_{nm}
6	Sigma of C_{nm}
7	Sigma of S_{nm}
8	Normalization flag If = −1.0, coefficients are normalized Otherwise, coefficients are unnormalized

UNFORMATTED EPHEMERIS FILE FORMAT

A. Ephemeris Records

Number	Type	Contents
1	DP	Julian date (UTC)
6	R	Satellite state (x, y, z, $\dot{x}$, $\dot{y}$, $\dot{z}$)

ASCII EPHEMERIS INTERCHANGE FORMAT

A. Header Record

Format (132A1)

Item	Format	Description
1–132	A1	Verbal description of run

B. Ephemeris Records

Format (6D22.16/6D22.16)

Item	Format	Description
1	D22.16	Julian Date (Integral Part) (UTC)
2	D22.16	Fractional Julian Date (UTC)
3	D22.16	Greenwich Hour Angle (degrees)
4–6	3D22.16	Satellite position x, y, z (meters)
1–3	3D22.16	Satellite velocity $\dot{x}$, $\dot{y}$, $\dot{z}$ (meters/seconds)
4	D22.16	Satellite geodetic latitude (degrees)
5	D22.16	Satellite east longitude (degrees)
6	D22.16	Satellite height above reference ellipsoid (meters)

Note: Trajectory files can be input or output in several coordinate systems (mean-of-2000.0, mean-of-date, true-of-date, or body-fixed).

VARIATIONAL FILE FORMAT

	Record	Number	Type	Contents
File header				
	1	1	A10	program name and version number
		4	A70	run description
		1	A10	date of job
		1	A10	time of job
	2	1	I	number of arcs
Arc header				
	3	1	I	number of satellites (NS)
		1	I	number of force parameters excluding state (NF)
		1	I	arc number
		1	DP	arc epoch (UTC Julian date)
	4	N	A10	names of force parameters N = NF+6*NS
Variational records				
	For each time point:	1	R	UTC seconds past arc epoch
		6*NS	R	satellite state
		3*NS*N	R	partials of position wrt initial state and force parameters (by columns)
		3*NS*N	R	partials of velocity wrt initial state and force parameters (by columns)

Notes:

1. If there are additional arcs, the end of an arc is indicated by a short record.
2. Order of satellites assumed to match order in REGRES or DUZ files.

STANDARD OBSERVATION FORMATS FOR UTOPIA

UTOPIA observation files are simple text (ASCII) files of length 90 to 108 characters long, depending on the observation type. The observations are expected to be in time order.

Notes applicable to all observation types:

1) 299792458.0 m/sec should be used to scale time delay into meters.

2) All quantities are one-way; measurements which are implicitly two-way are divided by 2.

3) Corrections, when applied, have been added to the uncorrected measurement unless noted otherwise.

Additional notes may appear at the end of each observation type description.

STANDARD FORMAT FOR RIGHT ASCENSION AND DECLINATION

COLUMNS	SUBSET	DESCRIPTION
1-7		Satellite identification number
8-9		Measurement type
		10 = right ascension and declination
10-11		Time system indicators
	10	0 = ground received time 1 = satellite transponder/transmitter time 2 = ground transmitted time 3 = satellite receiver time
	11	0 = UT0 1 = UT1 2 = UT2 3 = UTC (USNO) 4 = A-1 (USNO) 5 = TAI (BIH) 6 = A-S (Smithsonian) 7 = UTC (BIH) 8 = GPS 9 = station dependent correction required
12-16		Station identification number
17-32		Time tag of observation
	17-18	Two digit year indicator (1950-2049)
	19-21	Day of year (January 1 = Day 1)
	22-26	Seconds from midnight
	27-32	Fractional part of seconds (microseconds)

COLUMNS	SUBSET	DESCRIPTION
33-36		Preprocessing indicators
	33-34	Not used
	35	0 = point considered to be good 1 = point flagged during preprocessing (coarse edit) 2 = point flagged during postprocessing (fine edit)
36-54		Observation data
	36-38	Right ascension degrees
	39-40	Right ascension arcminutes
	41-45	Right ascension arcseconds (xx.xxx)
	46-48	Declination degrees (sign is in column 46)
	49-50	Declination arcminutes
	51-54	Declinations arcseconds (xx.xx)
55-56		Equator designation
	55	1 = true; otherwise mean
	56	2 = equator of reference time 3 = equator of date all others = equator of 1950.0
57		Observation identifier 0 = active all others = passive
58-61		Standard deviation of right ascension (xx.xx arcminutes)
62-65		Standard deviation of declination (xx.xx arcminutes)
66-90		Spare

STANDARD FORMAT FOR LASER RANGE OBSERVATIONS

COLUMNS	SUBSET	DESCRIPTION
1-7		Satellite identification number
8-9		Measurement type
		20 = laser range
10-11		Time system indicators
	10	0 = ground received time 1 = satellite transponder/transmitter time 2 = ground transmitted time 3 = satellite receiver time
	11	0 = UT0 1 = UT1 2 = UT2 3 = UTC (USNO) 4 = A-1 (USNO) 5 = TAI (BIH) 6 = A-S (Smithsonian) 7 = UTC (BIH) 8 = GPS 9 = station dependent correction required
12-16		Station identification number
17-32		Time tag of observation
	17-18	Two digit year indicator (1950-2049)
	19-21	Day of year (January 1 = Day 1)
	22-26	Seconds from midnight
	27-32	Fractional part of seconds (microseconds)

COLUMNS	SUBSET	DESCRIPTION
33-35		Preprocessing indicators
	33	Data release indicator
	34	Tropospheric refraction correction 0 = correction applied 1 = correction not applied 2 = correction applied using correction formula for international laser data 3 = correction not applied; coefficient for international laser formula in columns 76-80 4 = correction applied and meteorological data is present 5 = correction not applied and meteorological data is present
	35	0 = point considered to be good 1 = point flagged during preprocessing (coarse edit) 2 = point flagged during postprocessing (fine edit)
36-54		Observation data
	36-45	Range (kilometers)
	46-54	Range (micrometers)
55		Normal point window 0 = not a normal point 1 = 5-second normal point 2 = 10-second normal point 3 = 15-second normal point 4 = 20-second normal point 5 = 30-second normal point 6 = 1-minute normal point 7 = 2-minute normal point 8 = 3-minute normal point 9 = 15-minute normal point
56		See columns 89-90

COLUMNS	SUBSET	DESCRIPTION
57-66		Meteorological data
	57-60	Surface pressure (millibars)
	61-63	Surface temperature (degrees Kelvin)
	64-66	Relative humidity (percent)
67-68		Crustal dynamics laser system ID number
69-73		Measurement standard deviation (millimeters)
74-75		Crustal dynamics occupancy sequence number
76-80		Tropospheric refraction correction (millimeters)
81		Speed of light indicator 0 = old speed of light (299792500. m/sec) 1 = new speed of light (299792458. m/sec)
82		Center of mass offset correction flag 0 = correction applied 1 = correction not applied
83-88		Center of mass offset correction (millimeters)
89-90		The digits in columns 56, 89 and 90 form the three digit number indicating the number of raw ranges compressed into the normal point

NOTES:

1. It is recommended that the center-of-mass and tropospheric corrections not be applied
2. The tropospheric refraction correction is applied by subtracting from the uncorrected observation (i.e., the negative sign is implicit).
3. The sign of the center-of-mass offset correction should be such that it would be added to the raw observation. For spherical satellites, this would be a positive number since the uncorrected range would be too short.

STANDARD FORMAT FOR RANGE-RATE OBSERVATIONS

COLUMNS	SUBSET	DESCRIPTION
1-7		Satellite identification number
8-9		Measurement type
		34 = USB doppler
		36 = PRARE doppler
		38 = TRANET doppler
		39 = DORIS doppler
10-11		Time system indicators
	10	0 = ground received time
		1 = satellite transponder/transmitter time
		2 = ground transmitted time
		3 = satellite receiver time
	11	0 = UT0
		1 = UT1
		2 = UT2
		3 = UTC (USNO)
		4 = A-1 (USNO)
		5 = TAI (BIH)
		6 = A-S (Smithsonian)
		7 = UTC (BIH)
		8 = GPS
		9 = station dependent correction required
12-16		Station identification number
17-32		Time tag of observation
	17-18	Two digit year indicator (1950-2049)
	19-21	Day of year (January 1 = Day 1)
	22-26	Seconds from midnight
	27-32	Fractional part of seconds (microseconds)

COLUMNS	SUBSET	DESCRIPTION
33-35		Preprocessing indicators
	33	0 = ionospheric correction applied 1 = ionospheric correction not applied
	34	0 = tropospheric correction applied 1 = tropospheric correction not applied 2 = correction applied (modeled met data) 3 = correction not applied (modeled met data)
	35	0 = point considered to be good 1 = point flagged during preprocessing (coarse edit) 2 = point flagged during postprocessing (fine edit)
36-45		Count interval in 0.1 microseconds
46-56		Range-rate in micrometers/second
57-66		Meteorological data
	57-60	Surface pressure (millibars)
	61-63	Surface temperature (degrees Kelvin)
	64-66	Relative humidity (percent)
67-72		Measurement standard deviation (micrometers/second)
73-80		Ionospheric refraction correction (micrometers/second)
81-87		Tropospheric refraction correction (micrometers/second)
88		Center-of-mass offset correction flag 0 = correction applied 1 = correction not applied
89-94		Center-of-mass offset correction (micrometers/second)
95-96		Spare

NOTES:

1. The time tag must correspond to the end of the count interval.

2. Center-of-mass offset correction should include ground and satellite phase center corrections.

STANDARD FORMAT FOR ALTIMETER OBSERVATIONS

COLUMNS	SUBSET	DESCRIPTION
1-7		Satellite identification number
8-9		Measurement type
		41 = altimeter height
		46 = crossover height
10-11		Time system indicators
	10	0 = ground received time
		1 = satellite transponder/transmitter time
		2 = ground transmitted time
		3 = satellite receiver time
	11	0 = UT0
		1 = UT1
		2 = UT2
		3 = UTC (USNO)
		4 = A-1 (USNO)
		5 = TAI (BIH)
		6 = A-S (Smithsonian)
		7 = UTC (BIH)
		8 = GPS
		9 = station dependent correction required
12-14		Significant wave height (0.1 m)
15-16		Geophysical correction flags
	15	0 = geoid correction applied
		1 = geoid correction not applied
	16	0 = tide correction applied
		1 = tide correction not applied
17-32		Time tag of observation
	17-18	Two digit year indicator (1950-2049)
	19-21	Day of year (January 1 = Day 1)
	22-26	Seconds from midnight
	27-32	Fractional part of seconds (microseconds)

COLUMNS	SUBSET	DESCRIPTION
33-36		Preprocessing indicators
	33	Ionospheric refraction correction 0 = correction applied 1 = correction not applied
	34	Tropospheric refraction correction (even = applied; odd = not applied) 0-1 wet & dry ECMWF 2-3 wet measured, dry ECMWF 4-5 wet & dry FNOC, FMET or other model 6-7 wet measured, dry FNOC, FMET or model 8-9 other
	35	0 = point considered to be good 1 = point flagged during preprocessing (coarse edit) 2 = point flagged during postprocessing (fine edit)
	36	0 = point is over sea 1 = point is over land 2 = point is over ice 3 = point is over deep sea 9 = point is over lake or inland sea
37-46		Altimeter height measurement (millimeters)
47-49		$\sigma 0$ (0.1 dB)
50-52		Ionospheric refraction correction (millimeters)
53-55		Wet tropospheric refraction correction (millimeters)
56-58		Dry tropospheric refraction correction (millimeters) (2.0 m removed)
59		Center-of-mass correction flag 0 = correction applied 1 = correction not applied
60		Surface correction indicator Octal integer = binary ijk: i pole tide (0=corrected, 1=not corrected) j sea-state bias (0=corrected 1=not corrected) k inverted barometer (0=corrected, 1=not corrected)

COLUMNS	SUBSET	DESCRIPTION
61-64		Solid earth tide height (millimeters)
65-71		Geoid height (millimeters) for altimeter Index of matching height measurement for crossover
72-76		Ocean tide height (millimeters)
77-85		Satellite geodetic latitude (microdegrees)
86-94		Satellite east longitude (microdegrees)
95-104		Satellite height above reference ellipsoid (millimeters)
105-107		Automatic gain control (0.1 dB) (for ERS-1/-2, observation _ in millimeters)
108		Pass indicator (where available) A = ascending pass D = descending pass

Optional quantity appearing in some data sets; information not necessarily preserved by all programs which process altimeter data

109-111		Sea-state bias correction (millimeters)

NOTES:

1. The altimeter height measurement should have all corrections applied except for the geoid height and the inverted barometer effect.

2. Tropospheric, ionospheric and sea-state bias (where available) have been applied by subtracting from the uncorrected observation (i.e., the negative sign is implicit).

3. In general, all instrumental corrections should be applied to the observation.

4. The measured mean sea height above the reference ellipsoid is obtained by subtracting the corrected altimeter height measurement from the satellite height

5. The reference ellipsoid defined by ae = 6378136.3 m and flattening of 1/298.257.

SUPERSEDED FORMAT FOR ALTIMETER OBSERVATIONS

COLUMNS	SUBSET	DESCRIPTION
1-7		Satellite identification number
8-9		Measurement type
		40 = altimeter height 45 = crossover height
10-11		Time system indicators
	10	0 = ground received time 1 = satellite transponder/transmitter time 2 = ground transmitted time 3 = satellite receiver time
	11	0 = UT0 1 = UT1 2 = UT2 3 = UTC (USNO) 4 = A-1 (USNO) 5 = TAI (BIH) 6 = A-S (Smithsonian) 7 = UTC (BIH) 8 = GPS 9 = station dependent correction required
12-14		Significant wave height (0.1 m)
15-16		Geophysical correction flags
	15	0 = geoid correction applied 1 = geoid correction not applied
	16	0 = tide correction applied 1 = tide correction not applied
17-32		Time tag of observation
	17-18	Two digit year indicator (1950-2049)
	19-21	Day of year (January 1 = Day 1)
	22-26	Seconds from midnight
	27-32	Fractional part of seconds (microseconds)

COLUMNS	SUBSET	DESCRIPTION
33-36		Preprocessing indicators
	33	Ionospheric refraction correction 0 = correction applied 1 = correction not applied
	34	Tropospheric refraction correction (even = applied; odd = not applied) 0-1 wet & dry from model 2-3 wet measured, dry modeled
	35	0 = point considered to be good 1 = point flagged during preprocessing (coarse edit) 2 = point flagged during postprocessing (fine edit)
	36	0 = point is over sea 1 = point is over land 2 = point is over ice 3 = point is over deep sea
37-45		Altimeter height measurement (millimeters)
46-48		s0 (0.1 dB)
49-52		ionospheric refraction correction (centimeters)
53-55		Wet tropospheric refraction correction (centimeters)
56-58		Dry tropospheric refraction correction (centimeters)
59		Center-of-mass correction flag 0 = correction applied 1 = correction not applied
60-62		Automatic gain control (0.1 dB)
63-66		Solid earth tide height (centimeters)
67-72		Geoid height (centimeters) for altimeter Index of matching height measurement for crossover

COLUMNS	SUBSET	DESCRIPTION
73-76		Ocean tide height (centimeters)
77-85		Satellite geodetic latitude (microdegrees)
86-94		Satellite east longitude (microdegrees)
95-103		Satellite height above reference ellipsoid (centimeters)
104-106		Number of points compressed into measurement
107		Normal point window 0 = not a normal point 1 = 5-second normal point 2 = 10-second normal point 3 = 15-second normal point 4 = 20-second normal point 5 = 30-second normal point 6 = 1-minute normal point 7 = 2-minute normal point 8 = 3-minute normal point 9 = 15-minute normal point
108		Release indicator

NOTES:

1. The altimeter height measurement should have all corrections applied except for the geoid height and the inverted barometer effect.

2. The tropospheric and ionospheric refraction corrections have been applied by subtracting from the uncorrected observation (i.e., the negative sign is implicit).

3. In general, all instrumental corrections should be applied to the observation.

4. The measured mean sea height above the reference ellipsoid is obtained by subtracting the corrected altimeter height measurement from the satellite height

5. The reference ellipsoid defined by ae = 6378136.3 m and flattening of 1/298.257.

6. A field is filled with 9’s if the value exceeds the format limits.

MODIFIED FORMAT FOR GEOS-3 ALTIMETER OBSERVATIONS

COLUMNS	SUBSET	DESCRIPTION
1-7		Satellite identification number
8-9		Measurement type
		40 = altimeter height 45 = crossover height
10-11		Time system indicators
	10	0 = ground received time 1 = satellite transponder/transmitter time 2 = ground transmitted time 3 = satellite receiver time
	11	0 = UT0 1 = UT1 2 = UT2 3 = UTC (USNO) 4 = A-1 (USNO) 5 = TAI (BIH) 6 = A-S (Smithsonian) 7 = UTC (BIH) 8 = GPS 9 = station dependent correction required
12-14		Significant wave height (0.1 m)
15-16		Geophysical correction flags
	15	0 = geoid correction applied 1 = geoid correction not applied
	16	0 = tide correction applied 1 = tide correction not applied
17-32		Time tag of observation
	17-18	Two digit year indicator (1950-2049)
	19-21	Day of year (January 1 = Day 1)
	22-26	Seconds from midnight
	27-32	Fractional part of seconds (microseconds)

COLUMNS	SUBSET	DESCRIPTION
33-36		Preprocessing indicators
	33	Ionospheric refraction correction 0 = correction applied 1 = correction not applied
	34	Tropospheric refraction correction (even = applied; odd = not applied) 0-1 wet & dry from model 2-3 wet measured, dry modeled
	35	0 = point considered to be good 1 = point flagged during preprocessing (coarse edit) 2 = point flagged during postprocessing (fine edit)
	36	0 = point is over sea 1 = point is over land 2 = point is over ice 3 = point is over deep sea
37-45		Altimeter height measurement (millimeters)
46-48		_0 (0.1 dB)
49-52		Wind speed (centimeters/sec)
53-58		Along-track slope of altimeter measurement (mrad)
59		Center-of-mass correction flag 0 = correction applied 1 = correction not applied
60-62		Automatic gain control (dB)
63-66		Solid earth tide height (centimeters)
67-72		Geoid height (centimeters) for altimeter Index of matching height measurement for crossover

COLUMNS	SUBSET	DESCRIPTION
73-76		Ocean tide height (centimeters)
77-85		Satellite geodetic latitude (microdegrees)
86-94		Satellite east longitude (microdegrees)
95-103		Satellite height above reference ellipsoid (centimeters)
104-106		Number of points compressed into measurement
107		Normal point window
		0 = 1-second normal point
108		Release indicator

NOTES:

1. For solid tide height, Cartwright's solid Earth tide model was used with zero-frequency term not included (h2 = 0.61, h3 = 0.29)

2. For ocean tide height, Schwiderski's ocean tide model was used with 9 terms included (M2, S2, K1, O1, N2, P1, K2, Q1, Mf)

3. The measured mean sea height above the reference ellipsoid is obtained by subtracting the corrected altimeter height measurement from the satellite height

4. The reference ellipsoid defined by ae = 6378145 m and flattening of 1/298.255.

5. A field is filled with 9's if the value exceeds the format limits (except that significant wave height and s0 are set to 0).

6. The along-track slope was calculated with forward differencing.

STANDARD FORMAT FOR AZIMUTH AND ELEVATION OBSERVATIONS

COLUMNS	SUBSET	DESCRIPTION
1-7		Satellite identification number
8-9		Measurement type
		70 = laser azimuth and elevation angles
10-11		Time system indicators
	10	0 = ground received time
		1 = satellite transponder/transmitter time
		2 = ground transmitted time
		3 = satellite receiver time
	11	0 = UT0
		1 = UT1
		2 = UT2
		3 = UTC (USNO)
		4 = A-1 (USNO)
		5 = TAI (BIH)
		6 = A-S (Smithsonian)
		7 = UTC (BIH)
		8 = GPS
		9 = station dependent correction required
12-16		Station identification number
17-32		Time tag of observation
	17-18	Two digit year indicator (1950-2049)
	19-21	Day of year (January 1 = Day 1)
	22-26	Seconds from midnight
	27-32	Fractional part of seconds (microseconds)

COLUMNS	SUBSET	DESCRIPTION
33-35		Preprocessing indicators
	33	Not used
	34	Tropospheric refraction correction 0 = correction applied 1 = correction not applied
	35	0 = point considered to be good 1 = point flagged during preprocessing (coarse edit) 2 = point flagged during postprocessing (fine edit)
36-55		Observation data
	36-38	Azimuth ascension degrees
	39-40	Azimuth ascension arcminutes
	41-45	Azimuth ascension milliarcseconds
	46-48	Elevation degrees
	49-50	Elevation arcminutes
	51-55	Elevation milliarcseconds
56-57		Spare
58-61		Standard deviation of azimuth (arcseconds)
62-65		Standard deviation of elevation (arcseconds)
66		Spare
67-71		Tropospheric refraction correction to azimuth (arcseconds)
72-76		Tropospheric refraction correction to elevation (arcseconds)
77-78		Crustal dynamics laser system ID number
79-80		Crustal dynamics occupancy sequence number
81-90		Spare

STANDARD FORMAT FOR RADIOMETRIC RANGE OBSERVATIONS

COLUMNS	SUBSET	DESCRIPTION
1-7		Satellite identification number
8-9		Measurement type
		80 = biased range (integrated one-way doppler)
		81 = PRARE range
10-11		Time system indicators
	10	0 = ground received time
		1 = satellite transponder/transmitter time
		2 = ground transmitted time
		3 = satellite receiver time
	11	0 = UT0
		1 = UT1
		2 = UT2
		3 = UTC (USNO)
		4 = A-1 (USNO)
		5 = TAI (BIH)
		6 = A-S (Smithsonian)
		7 = UTC (BIH)
		8 = GPS
		9 = station dependent correction required
12-16		Station identification number
17-32		Time tag of observation
	17-18	Two digit year indicator (1950-2049)
	19-21	Day of year (January 1 = Day 1)
	22-26	Seconds from midnight
	27-32	Fractional part of seconds (microseconds)

COLUMNS	SUBSET	DESCRIPTION
33-37		Preprocessing indicators
	33	0 = ionospheric correction applied 1 = ionospheric correction not applied
	34	0 = tropospheric correction applied 1 = tropospheric correction not applied 2 = correction applied (modeled met data) 3 = correction not applied (modeled met data)
	35	0 = point considered to be good 1 = point flagged during preprocessing (coarse edit) 2 = point flagged during postprocessing (fine edit)
	36	0 = no multipath detected 1 = multipath detected
	37	0 = phase continuity maintained 1 = phase continuity lost
38-41		Campaign ID
42-52		Range (millimeters)
53-55		Number of points compressed into data
56		Normal point window
		0 = not a normal point 1 = 5-second normal point 2 = 10-second normal point 3 = 15-second normal point 4 = 20-second normal point 5 = 30-second normal point 6 = 1-minute normal point 7 = 2-minute normal point 8 = 3-minute normal point 9 = 15-minute normal point

COLUMNS	SUBSET	DESCRIPTION
57-66		Meteorological data
	57-60	Surface pressure (millibars)
	61-63	Surface temperature (degrees Kelvin)
	64-66	Relative humidity (percent)
67-70		Measurement standard deviation (millimeters)
71-77		Ionospheric refraction correction (millimeters)
78-82		Tropospheric refraction correction (millimeters)
83-88		Center of mass offset correction (millimeters)
89		Center of mass offset correction flag 0 = correction applied 1 = correction not applied
90-94		Ground antenna phase center correction (millimeters)
95		Phase center correction flag 0 = correction applied 1 = correction not applied
96		Release flag

NOTES:

1. Center-of-mass offset correction should include satellite phase center corrections.

2. For PRARE data, the tropospheric and ionospheric refraction corrections have been applied by subtracting from the uncorrected observation (i.e., the negative sign is implicit).

UTOPIA GEOID FILES

Geoid information is required in most analyses of satellite altimeter data. For such applications, the area over which the geoid height has been determined is sufficiently small that a global or a regional geoid requires considerable computer storage. For example, a complete $1^\circ \times 1^\circ$ global geoid requires 64,442 values of the geoid height at the grid points, including the poles. Clearly, smaller grid sizes would exceed the memory capacity of most computers. Since programs compete for priority in a multi-user environment based on memory requirements, storage of a large geoid in main memory is impractical even aside from capacity limitations, and alternate methods of handling large data bases are necessary.

Other mass storage devices offer large capacity but a slower retrieval speed. Devices such as magnetic disk offer two modes of retrieval, namely, sequential and direct access. Since the use of altimeter data in chronological order would necessitate sequential geoid retrieval in a manner consistent with the nature of the orbital ground track, such a data base structure would be dependent on the orbital inclination. To avoid such data base dependence on the orbital characteristics, a direct or random access data base structure was adopted for UTOPIA applications.

By dividing the globe into n° geodetic latitude by m° longitude blocks, a file structure was chosen in which each logical record corresponds to such a block. The block itself is further subdivided into a $p' \times q'$ grid in which each grid point has a geoid height associated with it. With an appropriate algorithm, the record number may be computed for any given geodetic latitude/longitude set and the record can be directly read without reading or skipping previous records as would be required in sequential access procedures. Once the record has been retrieved and the geoid values stored in memory, a further computation would provide the particular

location within memory of the desired geoid height or nearby value.

The blocks defined on the globe are illustrated in Figure 1. The procedure for definition is to define the minimum geodetic latitude (LATMIN), minimum longitude (LONGMIN), maximum geodetic latitude (LATMAX) and maximum longitude (LONGMAX). Adopting the block numbering system shown in Figure 1 which begins with the lower left block, the block number, BN, for a given geodetic latitude, ϕ, and longitude, λ, can be computed from the following procedure:

$$I = \text{Integer}\left(\frac{\phi - \text{LATMIN}}{n}\right)$$

$$J = \text{Integer}\left(\frac{\lambda - \text{LONGMIN}}{m}\right)$$

$$BN = J * IROW + I + 1$$

where $IROW = \text{Integer}\left(\frac{\text{LATMAX} - \text{LATMIN}}{n}\right)$.

Although not given, it is understood that ϕ and λ must be validated to be in the range specified by LATMIN, LATMAX, LONGMIN and LONGMAX.

The actual structure of UTOPIA geoid files includes a header record which contains the following information:

Header Record (704 60-bit words)

Words 1-14	Text identifying the geoid
15	LATMIN
16	LONGMIN
17	LATMAX
18	LONGMAX
19	n (degrees)
20	m (degrees)
21	p (arc minutes)
22	q (arc minutes)
23	Number of geoid values in each data record
24-704	Unused

Each subsequent data record corresponds to the block number (BN) and is also 704 words long. (The value 704 was chosen to optimize the direct access operation since it is an exact multiple of 1 disk PRU.) By using such a header to define characteristics of the blocks, a variety of special geoids can be used without requiring changes to the software which retrieves the data.

Within each record (or block), the geoid heights are stored sequentially as illustrated in Figure 2. Each grid intersection is associated with three values, namely, a geodetic latitude, a longitude and a geoid height. However, the geodetic latitude and longitude are not stored within the record since they can be determined from the record number. That is, a given record represents a region which is defined by a maximum and a minimum geodetic latitude and longitude, where the record number can be computed from the header information and the given geodetic latitude and longitude. The sequence of geoid height storage within the record is shown in Figure 2. The reason for the adopted storage order is to enable retrieval of the data directly into a Fortran array, such as GEOID (4,4) where the first subscript would represent the geodetic latitude and the second would represent the longitude.